IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.	: 08/428,325	Confirmation No.	: 4905
First Named Inventor	: Masato OKABE		
Filed	: April 25, 1995		
Docket No.	: 105622.61827US		
Customer No.	: 23911		
Title	: Photoelectric Sensor, Information Recording Method, and Information Recording System		

RESPONSE TO NOTICE OF NON-RESPONSIVE REPLY

Mail Stop PETITION
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This paper is in response to the Notice of Non-Responsive Reply mailed June 15, 2009 for the above-identified application. Filed herewith pursuant to 37 C.F.R. §1.251(a)(1)(i) is a copy of the applicant's record of all of the correspondence between the Office and the applicant for the above-identified application. Set forth below pursuant to 37 C.F.R. § 1.251(a)(1)(ii) is a list of all of the correspondence between the Office and the applicant for the above-identified application that is part of applicant's record.

1. Correspondence #1:
   a. Application Fee Transmittal Sheet, dated April 25, 1995;
   b. 38 pages of Specification (in the Japanese language);
   c. 3 pages of claims (claims 1 – 18, in the Japanese language);
   d. 1 page Abstract (in the Japanese language);
   e. 30 sheets of drawings (Figs. 1 – 46, in the Japanese language);
   f. Check in the amount of $882, dated April 25, 1995;
   g. Return postcard, dated April 25, 1995;
   h. Certificate of Express Mail under 37 C.F.R. §1.10, dated April 25, 1995;
   i. United States Postal Service "Express Mail Post Office to Addressee" address form.

2. Correspondence #2:
    a. Notice To File Missing Parts of Application, Filing Date Granted, mailed May 18, 1995.

3. Correspondence #3:
    a. Response to Notice to File Missing Parts, dated August 16, 1995;
    b. Combined Declaration and Power of Attorney, executed on June 2, 1994;
    c. Declaration Pursuant to 37 C.F.R. §1.52(d), executed on June 7, 1995;
    d. 76 pages of Specification (English translation);
    e. 7 pages of claims (claims 1 – 18, English translation);
    f. 1 page Abstract (English translation);
    g. 30 sheets of drawings (Figs. 1 – 46, English translation);
    h. Petition and Fee for Extension of Time under 37 C.F.R. §1.136(a), dated August 16, 1995;
    i. Check in the amount of $260, dated August 11, 1995;
    j. Check in the amount of $370, dated August 11, 1995;
    k. Copy of Notice To File Missing Parts of Application;
    l. Return postcard, dated August 16, 1995;
    m. Certificate of Mailing under 37 C.F.R. §1.8a, dated August 16, 1995.

4. Correspondence #4:
    a. Recordation Form Cover Sheet pursuant to 37 C.F.R. §1.331, dated August 21, 1995;
    b. Assignment document, executed June 2, 1995;
    c. Check in the amount of $40;
    d. Return postcard, dated August 21, 1995;
    e. Certificate of Mailing under 37 C.F.R. §1.8a, dated August 21, 1995.

5. Correspondence #5:
    a. Notice of Recordation of Assignment Document, dated January 27, 1996, with copies of related applicant filings.

6. Correspondence #6:
    a. Information Disclosure Statement Under 37 C.F.R. §§1.56 and 1.97, dated February 13, 1996;
    b. Information Disclosure Citation (22 sheets);
    c. Concise Explanation of Relevance of Non-English Language; References, with concise explanations for additional references attached;
    d. Return Postcard, dated February 13, 1996;
    e. Certificate of Mailing under 37 C.F.R. §1.8a, dated February 13, 1996.

7. Correspondence #7:
    a. Filing Receipt, indicated to have been received by Morgan & Finnegan, LLP on September 22, 1997.

8. Correspondence #8:
   a. Office Communication, mailed September 15, 1999;
   b. Office Action Summary;
   c. Detailed Action, dated September 6, 1999;
   d. Notice of References Cited;
   e. Notice of Draftsperson's Patent Drawing Review.

9. Correspondence #9:
   a. Claim to Convention Priority, dated October 29, 1999;
   b. Japanese Application Serial No. 6-89489;
   c. Japanese Application Serial No. 7-91030;
   d. Return Postcard, dated October 29, 1999;
   e. Certificate of Mailing under 37 C.F.R §1.8a, dated October 29, 1999.

10. Correspondence #10:
   a. Amendment, dated March 15, 2000;
   b. Amendment Fee Transmittal, dated March 15, 2000;
   c. Petition and Fee for Extension of Time under 37 C.F.R. §1.136(a), dated March 15, 2000;
   d. Check in the amount of $870.00, dated March 14, 2000;
   e. Check in the amount of $314.00, dated March 15, 2000;
   f. Return Postcard, dated March 15, 2000;
   g. Certificate of Mailing under 37 C.F.R §1.8a, dated March 15, 2000.

11. Correspondence #11:
   a. Office Communication, mailed June 27, 2000 (Final Rejection);
   b. Office Action Summary;
   c. Detailed Action, dated June 26, 2000.

12. Correspondence #12:
   a. Continued Prosecution Application (CPA) Request Transmittal Pursuant to 37 C.F.R. §1.53(d), dated December 27, 2000;
   b. Petition and Fee for Extension of Time under 37 C.F.R. §1.136(a), dated December 27, 2000;
   c. Check in the amount of $890.00, dated December 27, 2000;
   d. Check in the amount of $710.00, dated December 27, 2000;
   e. Return Postcard, dated December 27, 2000;
   f. Express Mail Certificate, dated December 27, 2000;
   g. United States Postal Service "Express Mail Post Office to Addressee" address form.

13. Correspondence #13:
   a. Office Communication, mailed March 2, 2001 (Final Rejection);
   b. Office Action Summary;
   c. Detailed Action, dated February 28, 2001.

14. Correspondence #14:
    a. Corrected Filing Receipt, mailed April 24, 2001.

15. Correspondence #15:
    a. Notice of Appeal to the Board of Patent Appeals and Interferences, dated September 4, 2001;
    b. Petition and Fee for Extension of Time under 37 C.F.R. §1.136(a);
    c. Check in the amount of $890.00, dated September 4, 2001;
    d. Check in the amount of $310.00, dated September 4, 2001;
    e. Return Postcard, dated September 4, 2001;
    f. Certificate of Mailing under 37 C.F.R §1.8a, dated September 4, 2001.

16. Correspondence #16:
    a. Request For Continued Examination (RCE) Transmittal, dated November 5, 2001;
    b. Amendment, dated November 5, 2001;
    c. Return Postcard, dated November 5, 2001;
    d. Express Mail Certificate, dated November 5, 2001;
    e. United States Postal Service "Express Mail Post Office to Addressee" address form.

17. Correspondence #17:
    a. Status Inquiry, dated June 17, 2003;
    b. Return Postcard, dated June 18, 2003;
    c. Certificate of Mailing, dated June 18, 2003.

18. Correspondence #18:
    a. Notice of New or Revised Projected Publication Date, mailed January 29, 2004.

19. Correspondence #19:
    a. Notice of New or Revised Projected Publication Date, mailed February 3, 2005.

20. Correspondence #20:
    a. Facsimile Transmittal Sheet from Jackie Waldo, Tech Support Staff Manager, United States Patent and Trademark Office, to Mr. Marcus, dated August 9, 2006;
    b. Office Communication, with a mailing date indicated to be August 10, 2006;
    c. Notice Under 37 C.F.R. §1.251 – Pending Application;
    d. Palm Intranet Content Information for 08/428325, dated August 9, 2006.

21. Correspondence #21:
    a. Office Communication, mailed August 10, 2006;
    b. Notice Under 37 C.F.R. §1.251 – Pending Application;
    c. Palm Intranet Content Information for 08/428325, dated August 9, 2006.

22. Correspondence #22:
    a. Transmittal Of File Contents In Response To Notice Under 37 C.F.R. §1.251 – Pending Application, dated October 2, 2006;
    b. Return Postcard, indicated to have been received by OIPE on October 17, 2006.

23. Correspondence #23:
    a. Notice of New or Revised Projected Publication Date, mailed July 24, 2008.

24. Correspondence #24:
    a. Notice of Publication of Application, indicated to have been received by Morgan & Finnegan, LLP on October 8, 2008.

25. Correspondence #25:
    a. Office Communication cover sheet and Notice of Non-Responsive Reply, mailed June 15, 2009.

26. Correspondence #26:
    a. Returned Mail – Undeliverable As Addressed;
    b. Returned Office Communication cover sheet and Notice of Non-Responsive Reply, received by OIPE on June 22, 2009.

Statement Pursuant 37 C.F.R. §1.251(a)(1)(iii) – The copies of the correspondence submitted herewith comprise a complete and accurate copy of applicant's record of all of the correspondence between the Office and applicant for the above-identified application. Applicant is not presently aware of any correspondence between the Office and applicant for the above-identified application that is not among applicant's records.

Please credit any overpayment or charge any additional fees to the Deposit Account of Crowell & Moring LLP, Account Number 05-1323 (Docket No. 105622.61827US).

Respectfully submitted,

August 26, 2009

Bruce D. DeRenzi

Bruce D. DeRenzi
Registration No. 33,676
Telephone No. (212) 223-4000
Facsimile No. (212) 223-4134

CROWELL & MORING LLP
Intellectual Property Group
P.O. Box 14300
Washington, DC 20044-4300

PTO/SB/81 (01-09)
Approved for use through 11/30/2011. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

POWER OF ATTORNEY OR REVOCATION OF POWER OF ATTORNEY WITH A NEW POWER OF ATTORNEY AND CHANGE OF CORRESPONDENCE ADDRESS

Application Number	08/428,325
Filing Date	April 25, 1995
First Named Inventor	OKABE, Masato
Title	Photoelectric Sensor, ...
Art Unit	2815
Examiner Name	Kenneth A. Parker
Attorney Docket Number	105622.61827US

I hereby revoke all previous powers of attorney given in the above-identified application.

☐ A Power of Attorney is submitted herewith.

OR

☒ I hereby appoint Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith: **23911**

OR

☐ I hereby appoint Practitioner(s) named below as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith:

Practitioner(s) Name	Registration Number

Please recognize or change the correspondence address for the above-identified application to:

☒ The address associated with the above-mentioned Customer Number.

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the:

☐ Applicant/Inventor.

OR

☒ Assignee of record of the entire interest. See 37 CFR 3.71.
Statement under 37 CFR 3.73(b) (Form PTO/SB/96) submitted herewith or filed on ______________.

SIGNATURE of Applicant or Assignee of Record

Signature	Masanori Akada	Date	August 14, 2009
Name	Masanori AKADA	Telephone	
Title and Company	General Manager of Intellectual Property Division DAI NIPPON PRINTING CO., LTD.		

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☒ *Total of 1 forms are submitted.

PTO/SB/96 (07-09)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

STATEMENT UNDER 37 CFR 3.73(b)

Applicant/Patent Owner: Masato Okabe

Application No./Patent No.: 08/428,325 Filed/Issue Date: April 25, 1995

Titled: Photoelectric Sensor, Information Recording Method, and Information Recording System

Dai Nippon Printing Co., Ltd. , a corporation
(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.

states that it is:

1. [X] the assignee of the entire right, title, and interest in;

2. [ ] an assignee of less than the entire right, title, and interest in
(The extent (by percentage) of its ownership interest is ______ %); or

3. [ ] the assignee of an undivided interest in the entirety of (a complete assignment from one of the joint inventors was made)

the patent application/patent identified above, by virtue of either:

A. [ ] An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel ______, Frame ______, or for which a copy therefore is attached.

OR

B. [X] A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: Masato Okabe To: Dai Nippon Printing Co., Ltd.
The document was recorded in the United States Patent and Trademark Office at
Reel 007630 , Frame 0063 , or for which a copy thereof is attached.

2. From: Daigo Aoki, Mitsuhiro Kashiwabara, et al. To: Dai Nippon Printing Co., Ltd.
The document was recorded in the United States Patent and Trademark Office at
Reel 008337 , Frame 0273 , or for which a copy thereof is attached.

3. From: ______ To: ______
The document was recorded in the United States Patent and Trademark Office at
Reel ______, Frame ______, or for which a copy thereof is attached.

[ ] Additional documents in the chain of title are listed on a supplemental sheet(s).

[X] As required by 37 CFR 3.73(b)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (*i.e.*, a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

Masanori Akada
Signature

August 14, 2009
Date

Masanori AKADA
Printed or Typed Name

General Manager of Intellectual Property Division
Title

Patent Docket No. 105622.61827US

OIPE AUG 2 7 2009 PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.	: 08/428,325	Confirmation No.	:	4905
First Named Inventor	: Masato OKABE			
Filed	: April 25, 1995			
Art Unit.	: 2815			
Customer No.	: 23911			
Title	: Photoelectric Sensor, Information Recording Method, and Information Recording System			

EXPRESS MAIL CERTIFICATE (37 C.F.R. §1.8a)

Express Mail Label No.: **EM404543839US**
Date of Deposit: **August 27, 2009**

I hereby certify that the following attached paper(s) and/or fee:

1. Petition For Revival Of An Application For Patent Abandoned Unintentionally Under 37 CFR 1.137(b);
2. Response To Notice Of Non-Responsive Reply;
3. Copy Of Applicant's Record Of Correspondence Between The Office and Applicant (Correspondence Item Nos. 1 – 26);
4. Terminal Disclaimer To Accompany Petition;
5. Original Signed Revocation Of Power Of Attorney With A New Power Of Attorney And Change Of Correspondence Address;
6. Original Signed Statement Under 37 CFR 3.73(b);
7. Credit Card Payment Form (PTO-2038) In The Amount Of $1760.00, For Payment of Petition Fee Pursuant To 37 CFR 1.17(m) In The Amount Of $1,620.00, And Terminal Disclaimer Fee Pursuant To 37 CFR 1.20(d) In The Amount Of $140.00; and
8. Return Postcard.

(along with any paper(s) referred to as being attached or enclosed) and this Certificate of Mailing are being deposited with the United States Postal Service on the date shown below with sufficient postage as first-class mail in an envelope addressed to: Mail Stop Petition, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

August 27, 2009

Respectfully submitted,

Sean E. Jackson

Sean E. Jackson
Telephone No. (212) 803-4038
Facsimile No. (212) 223-4134

CROWELL & MORING LLP
Intellectual Property Group
P.O. Box 14300
Washington, DC 20044-4300

CORRESPONDENCE #1

PATENT
DOCKET NO.: 2122-4028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
APPLICATION FEE TRANSMITTAL

THE HONORABLE COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D. C. 20231

ATTENTION: BOX PATENT APPLICATION

Sir:

Transmitted herewith for filing is the patent application of:

Inventors : Masato OKABE

Title : PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD AND INFORMATION RECORDING SYSTEM

Enclosed are:

[X] 38 pages of specification (in the Japanese language, an English translation will follow in due course);

[X] 3 pages of claims (18 claims);

[X] 1 page of Abstract;

[X] 29 sheets of [X] **Informal** drawings (Figs. 1-46);

[ ] an executed Declaration and Power of Attorney;

[X] a check in the amount of $882.00 to cover the application filing fee (for Other Than A Small Entity) as determined in the Part I Calculation of Fees below.

[ ] an Assignment document and cover sheet for recordation to **DAI NIPPON PRINTING CO., LTD.**

[ ] a check in the amount of $40.00 to cover the Assignment recordation fee.

AUTHORIZATION TO CHARGE DEPOSIT ACCOUNT

[X] The Commissioner is hereby authorized to charge **any deficiencies in fees or credit any overpayment** to Deposit Account No. 13-4500. Order No. 2122-4028. A DUPLICATE COPY OF THIS SHEET IS ATTACHED.

EXPRESS MAIL LABEL NO.: EG 297333548 US

PATENT
DOCKET NO.: 2122-4028

I. CALCULATION OF APPLICATION FEE (For Other Than A Small Entity)

	Number Filed	Number Extra	Rate	Basic Fee $ 730.00
Total Claims*	18 - 20	= 0	x $22.00	$
Independent Claims	5 - 3	= 2	x $76.00	$ 152.00
Multiple Dependent Claim(s)	[ ] yes	Add'l Fee $240.00		
	[X] no	Add'l Fee NONE	=	$

Total: $ 882.00

II. CALCULATION OF APPLICATION FEE (For A Small Entity)

	Number Filed	Number Extra	Rate	Basic Fee $355.00
Total Claims*	-20	=	x $11.00	$
Independent Claims	- 3	=	x $37.00	$
Multiple Dependent Claim(s)	[ ] yes	Add'l Fee $115.00		
	[ ] no	Add'l Fee NONE	=	$

Total: $

Respectfully submitted,

MORGAN & FINNEGAN

Dated: **April 25, 1995**

By: ______________________
Christopher E. Chalsen
Reg. No. 30,936

Mailing Address:
MORGAN & FINNEGAN
345 Park Avenue
New York, New York 10154
(212) 758-4800 Telephone
(212) 751-6849 Facsimile

* Includes all independent and single dependent claims and all claims referred to in multiple dependent claims. See 37 C.F.R. § 1.75(c).

TITLE OF THE INVENTION

光センサ、情報記録方法及び装置

BACKGROUND OF THE INVENTION

本発明は、情報記録媒体への光情報を可視情報または静電情報の形で記録することができる光センサと情報記録媒体からなる情報記録システムに関し、特に情報記録媒体への情報記録性能が著しく増幅される光導電層を有する光センサ、情報記録方法、及び情報記録装置に関する。

前面に電極が設けられた光導電層からなる光センサと、該光センサに対向し、後面に電極が設けられた電荷保持層からなる情報記録媒体とを光軸上に配置し、両導電層間に電圧を印加しつつ露光し、入射光学像に応じて、電荷保持層に静電電荷を記録させ、その静電電荷をトナー現像するかまたは電位読み取りにより再生する方法は、例えば特開平１－２９０３６６号公報、特開平１－２８９９７５号公報に記載されている。また、前記方法における電荷保持層を熱可塑性樹脂層とし、静電電荷を熱可塑樹脂層表面に記録した後加熱し、熱可塑性樹脂層表面にフロスト像を形成することにより記録された静電電荷を可視化する方法は、例えば特開平３－１９２２８８号公報に記載されている。

更に、本出願人等は、前記情報記録媒体における情報記録層を高分子一液晶複合体層として、前記同様に電圧印加時露光し、光センサにより形成される電界により液晶層を配向させて情報記録を行い、情報記録の再生にあたっては透過光あるいは反射光により可視情報として再生する情報記録再生方法を、先に特願平４－１７３０３０号、特願平５－１０１２７７号として出願した。この情報記録再生方法は偏光板を使用しなくとも記録された情報を可視化できる。

このような光センサと液晶相からなる情報記録層を設けた情報記録方法では、電極間に電圧を印加しつつ情報光を入射させると、光が入射した部分の光導電層で発生した光キャリアは、両電極により形成される電界により移動し、電圧の再配分が行われ、情報記録層における液晶相が配向し、情報光のパターンに応じた記録が行なわれるものであり、情報光による露光を終了した後も電圧を印加し続けると光センサは導電性を持続し情報記録層に情報記録を継続することができる。そして、液晶によって動作電圧及びその範囲が異なるものもあるので、印加電

圧及び印加電圧時間を設定するにあたっては、情報記録媒体における電圧配分を適宜設定し、情報記録層に印加される電圧配分を液晶の動作電圧領域に設定することが行われており、この情報記録方法は、面状アナログ記録が可能であり、高解像度の記録となり、また露光パターンは液晶相の配向により可視像化されて保持される。

情報記録方法としては、カメラによる方法、またレーザーによる記録方法がある。カメラによる方法としては、通常のカメラに使用されている写真フィルムの代わりに情報記録媒体が使用され、記録部材とするもので、光学的なシャッタも使用しうるし、また電気的なシャッタも使用しうるものである。また、プリズム及びカラーフィルターにより光情報を、Ｒ、Ｇ、Ｂ光成分に分離し、平行光として取り出しＲ、Ｇ、Ｂの各色用の３個の情報記録媒体で１コマを形成するか、または１個の情報記録媒体の異なる部分にＲ、Ｇ、Ｂの各画像を記録して１コマとすることにより、カラー撮影することも可能である。

例えば、ガラス基板上に形成したＩＴＯ膜上にビスアゾ顔料を含有した光導電層を有する光センサに、２００Ｖの電圧を印加した状態で２０ｌｕｘのグリーン光を露光した場合の電流測定結果を図１に示す。未露光部分Ｌ２に比べて露光部Ｌ１の導電性が増加している。図２は、液晶からなる情報記録媒体をコンデンサと抵抗の並列回路とした時の液晶記録層に印加される電圧を露光部と未露光部についてのシミュレーションの結果を示す。未露光部に比べて露光部の導電性が大きいので、液晶記録層により多くの電圧が印加されるので、露光部の液晶が配向し画像を記録することができる。

このため、図１に示した露光部と未露光部の導電性の差がある程度の大きさにならないと液晶記録媒体に良好な画像を記録することができない。

また、このような方法で電圧を印加する場合、電圧印加時間と印加電圧には最適値があり、例えば電圧印加時間が長すぎる場合、未露光部の液晶記録媒体も配向し画像記録ができなくなる。

印加電圧を低くすることにより、電圧印加時間を長くすることもできるが、印加電圧を低くし過ぎた場合には、未露光部の液晶記録媒体の電圧がしきい値電圧に到達しないため、やはり画像記録をすることができない。

以上のように情報記録の際には、規定の時間内に電圧印加を終了する必要があり、それ以上電圧を印加しても有効に情報記録をすることができない。

電圧印加時間は、光センサあるいは情報記録媒体の特性によって異なるが、ほとんどの場合、２００ｍ秒以内であり、３０～５０ｍ秒程度の電圧印加時間で記録する場合が多く、電圧印加時間は未露光部の電流値により決まり、露光強度や露光時間にはほとんど依存しない。

広範な光強度範囲での記録が可能な銀塩写真では、露光強度の小さい画像を記録する場合に、露光時間を長くすることにより良好な画像を記録することができる。また、弱い光によって長時間露光する場合と強い光で短時間露光する場合のいずれの場合も極端な条件でない限りは同様な画像が記録できる相反則が成立する。

図３は、２００Ｖの電圧を印加した状態で６ｌｕｘの光を２００ｍ秒間露光したときの電流値を測定した結果であり、図４および図５は、それぞれ６ｌｕｘ、２０ｌｕｘで露光したときの露光部分と未露光部分の電流値の差を示している。

６ｌｕｘの強度で露光した場合、図４に示すように、長時間露光を続けることにより２０ｌｕｘで露光した場合と同程度の未露光部と露光部の差の光誘起電流を得ることができる。

しかし、このような光センサを用いて情報記録を行う場合、従来と同様に露光と同時に電圧印加を開始する方法では、電圧印加時間は３０～５０ｍ秒程度（未露光部がしきい値電圧に達するまでの時間）であるため、６ｌｕｘの光で露光した場合には、この時間内では２０ｌｕｘの強度で露光した場合に比べて小さい電流値しか得られないため、良好な画像を記録することができない。

このように、従来の方法で情報記録を行う場合、未露光部の電圧がしきい値電圧に達するまで電圧印加しても、露光強度が低い場合には情報記録を行うことができない。

また、電圧印加条件により記録される画像のラチチュードが狭いと、被写体を十分に表現することができず、ハイライトがとんでしまったり、シャドウ部分がつぶれてしまう等の問題がある。

また、最も一般的な画像記録方法である銀塩写真方式では、広い範囲で相反則

が成り立ち、例えば、絞りを開け（露光強度を強くする）、シャッタースピードを速くすることにより、被写体の特定部分にのみ焦点を合わせて、その前後をぼかして記録してみたり、逆に絞りを絞ってシャッタースピードを遅くして、被写体の前後の広い範囲に焦点を合わせて撮影する場合など、シャッタースピードと絞りを制御して露光量を同じにすることで相反則が成り立ち、容易に撮影することができる。また、晴天時の屋外撮影に使用する場合と夜景を撮影するような場合で、露光強度に応じてシャッタースピードを変化させることにより、同じフィルムを使用して撮影することができる。

しかし、光センサと液晶媒体を用いた本発明のシステムで画像記録を行う場合、電圧印加時間が終了した後に画像露光を続けても液晶媒体に記録することができないため、長時間露光ができず、撮影に必要な相反則が成り立たない。このように長時間露光では相反則が成り立たず、また、露光時間が極端に短い領域でも相反則が成り立たないため、様々な条件下で様々な被写体を撮影する場合、このような相反則不軌が問題となる。

SUMMARY OF THE INVENTION

本発明の目的は、露光強度の低い場合に長時間露光により情報記録媒体への情報記録を可能にすることである。

本発明の他の目的は、広いラチチュードでの画像記録を可能にすることである。

本発明の他の目的は、相反則不軌の領域における撮影時に、補正機能を持たせることにより、様々な条件下で、様々な画像情報を記録できるようにすることである。

本発明の光センサは、電極上に光導電層を有し、情報記録媒体への情報形成に使用される光センサにおいて、光センサに電圧を印加しない状態、または逆極性の電圧を印加した状態で、露光した後に電圧印加したときに、露光量に応じて光誘起電流が発生し、情報記録が可能であることを特徴とする。

また、本発明の光センサは、電極上に光導電層を有し、情報記録媒体への情報形成に使用される光センサにおいて、電圧を印加した状態で情報露光することによって露光部の導電性が未露光部の導電性よりも増加し、情報露光終了後も露光

した部分の導電性が、未露光部分の導電性よりも高く、さらに情報露光した状態、または情報露光終了後に、電圧印加を停止、または逆極性の電圧を印加した後、再びもとの電圧を印加することにより、電圧を印加し続けた場合と導電性が等しくなることを特徴とする。

また、本発明の光センサは、光センサへの10^5～10^6V／cm^{2}の電界の印加時に、未露光部での通過電流密度が10^{-4}～10^{-7}A／cm^{2}であることを特徴とする。

また、本発明の画像記録方法は、情報露光によって情報記録媒体へ光情報を記録する情報記録方法において、光センサと電極上に情報記録層を形成した情報記録媒体を使用し、光センサもしくは情報記録媒体の少なくともいずれか一方の電極を透明電極とするとともに、光センサと情報記録媒体を間隙を設けて光軸上に対向配置するか、または、光センサと情報記録媒体を直接または誘電体中間層を介して積層し、光情報の露光を行った後に、または光情報の露光中に両電極間に電圧印加を開始することを特徴とする。

また、本発明の情報記録方法は、前記情報記録媒体が、電極上に液晶と樹脂からなる高分子一液晶複合体層を形成した液晶記録媒体であることを特徴とする。

また、本発明の情報記録方法は、光情報の露光終了から一定時間経過後に電圧印加を開始することにより、記録する画像のラチチュードを広げることを特徴とする。

また、本発明の情報記録方法は、光情報の露光終了から電圧印加開始までの時間が０～５００ｍｓｅｃであることを特徴とする。

また、本発明の情報記録方法は、情報露光によって情報記録媒体へ光情報を記録する情報記録再生方法において、光センサと電極上に情報記録層を形成した情報記録媒体を使用し、光センサもしくは情報記録媒体の少なくともいずれか一方の電極を透明電極とするとともに、光センサと情報記録媒体を間隙を設けて光軸上に対向配置するか、または、光センサと情報記録媒体を直接または誘電体中間層を介して積層し、光情報の露光を行うとともに、光情報の露光を行っている間、または光情報の露光終了後に、電圧を印加しない期間もしくは逆極性の電圧を

印加する期間を設けることを特徴とする。

また、本発明の情報記録方法は、情報露光によって情報記録媒体へ光情報を記録する情報記録方法において、光センサと、電極上に情報記録層を形成した情報記録媒体を使用し、光センサもしくは情報記録媒体の少なくともいずれか一方の電極を透明電極とするとともに、光センサと情報記録媒体を間隙を設けて光軸上に対向配置するか、または、光センサと情報記録媒体を直接または誘電体中間層を介して積層し、光センサに情報露光し、光センサと情報記録媒体の両電極間に電圧印加して情報記録する方法において、シャッター速度に応じて、適切な画像露光と電圧印加方法を測定し、広い範囲で相反則が成り立つようにしたことを特徴とする。

また、本発明の情報記録方法は、予め測定しておいたシャッター速度と記録特性の関係を基に、絞り又は露光時間を補正することで広い範囲で相反則が成り立つようにしたことを特徴とする。

また、本発明の情報記録方法は、電圧印加開始前に画像露光を開始することにより、相反則不軌を補正することを特徴とする。

また、本発明の情報記録方法は、画像露光中または画像露光終了後に、電圧印加しない期間もしくは逆極性の電圧を印加する期間を設けることにより、相反則不軌を補正することを特徴とする。

また、本発明の情報記録方法は、画像露光終了後、一定時間経過後に電圧印加を開始することにより、相反則不軌を補正することを特徴とする。

また、本発明の情報記録方法は、印加電圧および／または電圧印加時間を制御することにより相反則不軌を補正することを特徴とする。

また、本発明の情報記録装置は、情報露光によって情報記録媒体へ光情報を記録する情報記録装置において、光センサと電極上に情報記録層を形成した情報記録媒体を使用し、光センサもしくは情報記録媒体の少なくともいずれか一方の電極を透明電極とするとともに、光センサと情報記録媒体を間隙を設けて光軸上に対向配置するか、または、光センサと情報記録媒体を直接または誘電体中間層を介して積層し、光情報の露光を行った後に、または光情報の露光中に両電極間に電圧印加を開始する機構を設けたことを特徴とする。

また、本発明の情報記録装置は、透明電極上に光導電層を積層した光センサと、電極上に情報記録層を積層した情報記録媒体を空隙を介して光軸上に対向配置するか、または、光センサの光導電層上に直接または誘電体中間層を介して情報記録層を積層し、さらに上部電極を形成した一体型媒体において、光センサに画像露光し、両電極間に電圧印加することにより、露光量に応じて画像情報等を記録する装置において、露光強度を測光し、露光時間を算出する手段を有し、および／または露光時間を入力する手段を有し、露光時間の広い範囲で相反則が成り立つように、露光時間に応じて適切な条件でシャッターと電源を制御する機能を有することを特徴とする。

BRIEF DESCRIPTION OF THE DRAWINGS

図１は、電圧の印加と露光を同時に行う光センサ電流測定結果を示す図、

図２は、液晶とそれを保持する樹脂からなる情報記録媒体をコンデンサと抵抗の並列回路とした時の液晶記録層に印加される電圧を露光部と未露光部についてのシミュレーションの結果を示す図、

図３は、２００Ｖの電圧を印加した状態で６１ｕｘの光を２００ｍ秒間露光したときの電流値を測定した結果を示す図、

図４は、６１ｕｘで露光したときの露光部分と未露光部分の電流値の差を示す図、

図５は、２０１ｕｘで露光したときの露光部分と未露光部分の電流値の差を示す図、

図６は、光センサを説明するための断面図、

図７は、本発明の方法に使用する情報記録装置を説明する断面図、

図８は、本発明の情報記録装置への情報記録方法について説明する図、

図９は、繰り返し電圧印加した場合の液晶記録層および光センサに印加される電圧の変化の一例を説明する図、

図１０は、多重露光による画像情報を記録する方法を説明する図、

図１１は、本発明の光センサの特性の測定方法を説明する図、

図１２は、光センサの電気的特性を説明する図、

図１３は、明電流と暗電流との差で表される光誘起電流を説明する図、

図１４は、電圧印加と露光の開始時点をずらした場合に、明電流と暗電流を測定した結果を説明する図、

図１５は、異なる電圧印加露光方法での電流測定したときの光誘起電流の測定結果を説明する図、

図１６は、一定電圧を印加した場合と矩形波電圧を印加した状態で露光した場合の光誘起電流の測定結果を説明する図、

図１７は、一定電圧を印加した場合と矩形波電圧を印加した状態で露光した場合の他の例の光誘起電流の測定結果を説明する図、

図１８は、液晶記録媒体の等価回路を説明する図、

図１９は、光センサの情報記録性能を説明する図、

図２０は、露光終了後に電圧を印加した場合の光誘起電流の測定結果を説明する図、

図２１は、露光終了後に電圧を印加した場合の光誘起電流の他の測定結果を説明する図、

図２２は、露光終了後に電圧を印加した場合の光誘起電流の他の測定結果を説明する図、

図２３は、露光部と未露光部に電圧の差をシミュレーションした結果を説明する図、

図２４は、電圧印加した状態で画像露光し、照射光強度を変化させたときの光誘起電流の測定結果を示す図、

図２５は、ラチチュードを変えるための画像記録装置の構成を示す図、

図２６は、画像露光開始から電圧印加開始までの時間を変える画像記録方法を説明する図、

図２７は、図２６の方法で画像記録したときの測定結果を示す図、

図２８は、露光時間を長くした場合の光誘起電流の測定結果を示す図、

図２９は、電圧印加中に画像露光する記録方法を示す図、

図３０は、相反則不軌を説明する図、

図３１は、電圧印加中又は電圧印加後も露光継続する電圧印加・露光方法を説明する図、

図３２は、電圧印加開始前に画像露光を開始する電圧印加・露光方法を説明する図、

図３３は、電圧印加同時露光と電圧印加前に画像露光した場合の読み取り信号の測定結果を示す図、

図３４は、電圧印加開始前に画像露光する記録方法を示す図、

図３５は、電圧印加同時露光と電圧印加開始前に画像露光した場合の読み取り信号の測定結果を示す図、

図３６は、画像露光から電圧印加開始までの時間を変化させる電圧印加・露光方法を説明する図、

図３７は、印加電圧を高く設定した場合の読み取り信号の測定結果を示す図、

図３８は、図３７において、未露光部分と露光部分の透過率の間で規格化した結果を示す図、

図３９は、シンクロ撮影方法を説明する図、

図４０は、長時間画像露光中に複数回電圧印加をする記録方法を示す図、

図４１は、本発明の画像記録装置の構成を示す図、

図４２は、本発明の記録方法を適用したカメラを示す図、

図４３は、媒体ホルダを示す図、

図４４は、画像シーケンスの１例を示す図、

図４５は、画像シーケンスの他の例を示す図、および

図４６は画像シーケンスの他の例を示す図である。

DESCRIPTION OF THE PREFERRED EMBODYMENT

本発明の光センサは、電極上に光導電層を積層してなり、その光導電層は単層型のものと電荷発生層及び電荷輸送層を積層した積層型のものがある。光導電層は、一般には光が照射されると照射部分で光キャリア（電子、正孔）が発生し、それらのキャリアが層幅を移動することができる機能を有するものであるが、本発明の光センサは後述する光導電層と電極とを適宜組み合わせ、半導電性を持たせることにより、光センサへの光照射時において情報記録媒体に付与される電界または電荷量が光照射につれて経時的に増幅され、また光照射を終了した後でも電圧を印加し続けるとその増加した導電性を持続し、引続き電界または電荷量を

情報記録媒体に付与し続ける作用を有するに到るものである。

本発明の光センサは、持続導電性および増幅作用を有しているが、従来から知られている持続導電性を有するといわれている光感光体は、本来は絶縁性のものであり、これに光照射等によって導電性を与える過程において、持続導電性が生じるものである。これに対して、本発明の光センサは、もともと半導電性の特性を有しており、このことが本発明の作用を得るための要件であり、絶縁性のものでは本発明の作用を得ることはできない。

図６は、光センサを説明するための断面図である。

光センサ１０は、基板１１上に形成した電極１２上に、光導電層１３が設けられており、光導電層１３は電荷発生層１４および電荷輸送層１５から構成されている。光導電層は光が照射されると照射部分で電子、正孔等の光キャリアが発生し、それらのキャリアが層幅を移動することができる導電性層であり、とくに電界が存在する場合に、その効果が顕著である層である。

電荷発生層１４は、バインダー樹脂と電荷発生性物質からなり、電荷発生性物質としては、特願平５－４７２１号に記載されているようなピリリウム系染料、チアピリリウム系染料、アズレニウム系染料、シアニン系染料、アズレニウム系染料等のカチオン系染料、スクバリリウム塩系染料、フタロシアニン系顔料、ペリレン系顔料、ピラントロン系顔料等の多環キノン系顔料、インジゴ系顔料、キナクリドン系顔料、ピロール系顔料、アゾ系顔料等の染料、顔料を単層中で複数のものを組み合わせて使用することができる。また、電荷発生層を２層設け、それぞれの層に単一の電荷発生性物質を使用してもよい。

また、電荷発生層には、電子受容性物質を添加してもよい。電子受容性物質としては、２，４，７－トリニトロフルオレノン、テトラフルオローＰ－ベンゾキノン、テトラシアノキノジメタン、トリフェニルメタン、無水マレイン酸、ヘキサシアノブタジエン等を使用することができる。

バインダー樹脂としては、例えばポリ塩化ビニル樹脂、ポリ酢酸ビニル樹脂、アクリル樹脂、ポリエステル樹脂、ポリビニルホルマール樹脂、ポリビニルブチラール樹脂、ポリスチレン樹脂、ポリカーボネート樹脂、ポリブチルメタクリレート樹脂、ポリ塩化ビニリデン樹脂、エチルセルロース樹脂、シリコーン樹脂、

エポキシ樹脂、フェノール樹脂、メラミン樹脂、紫外線硬化性樹脂、熱硬化性樹脂、塩化ビニル－酢酸ビニル共重合体樹脂、塩化ビニル－アクリル共重合体樹脂、塩化ビニル－エチレン共重合体樹脂、アクリル－スチレン共重合体樹脂、スチレン－ブタジエン共重合体樹脂、エチレン－酢酸ビニル共重合体樹脂等が挙げられる。

使用するバインダー樹脂は、分子量が大きくなると塗布特性が好ましくないので、平均分子量が１，０００～１００，０００のものを使用することが好ましい。

これらの電荷発生性物質とバインダー樹脂との混合比は、電荷発生性物質１重量部に対してバインダーを０～１０重量部、好ましくは０．３～１重量部の割合で使用するとことが望ましい。電子受容性物質は、電荷発生性物質１モルに対して０，０００１～１０モルの割合で使用することができる。電荷発生層は乾燥後膜厚として０．０１～１μｍであり、好ましくは０．１～０．３μｍとするとよい。

電荷輸送層１５は電荷輸送性物質とバインダーとから構成されている。電荷輸送性物質は、電荷発生性物質で発生した電荷の輸送特性が良い物質であり、例えばオキサジアゾール系、オキサゾール系、トリアゾール系、チアゾール系、トリフェニルメタン系、スチリル系、ピラゾリン系、ヒドラゾン系、芳香族アミン系、カルバゾール系、ポリビニルカルバゾール系、スチルベン系、エナミン系、アジン系、アミン系、ブタジエン系、多環芳香族化合物系等があり、ホール輸送性の良い物質とすることが必要である。

好ましくは、ブタジエン系、スチルベン系電荷輸送性物質が挙げられ、具体的には特開昭６２－２８７２５７号公報、特開昭５８－１８２６４０号公報、特開昭４８－４３９４２号公報、特公昭３４－５４６６号公報、特開昭５８－１９８０４３号公報、特開昭５７－１０１８４４号公報、特開昭５９－１９５６６０号公報、特開昭６０－６９６５７号公報、特開昭６４－６５５５５号公報、特開平１－１６４９５２号公報、特開昭６４－５７２６３号公報、特開昭６４－６８７６１号公報、特開平１－２３００５５号公報、特開平１－１４２６５４号公報、特開平１－１４２６５５号公報、特開平１－１５５３５８号公報、特開平１－１

５５３５７号公報、特開平１－１６１２４５号公報、特開平１－１４２６４３号公報等に記載した電荷輸送材料が挙げられる。

これらの電荷発生性物質と電荷輸送性物質の組合せとしては、例えばフルオレノンアゾ顔料（電荷発生性物質）とスチルベン系、トリフェニルアミン系の電荷輸送性物質の組合せ、ビスアゾ系顔料（電荷発生性物質）とブタジエン系、ヒドラゾン系の電荷輸送性物質の組合せ等が良好である。

また、以上のように電荷として正孔を輸送することに代えて電子を輸送する場合には、電子輸送物質としては、特願平５－４７２１号に記載の電子輸送物質を用いることができる。　バインダー樹脂としては、上記した電荷発生層におけるバインダー樹脂と同様のものが使用できるが、好ましくはポリ塩化ビニル樹脂、ポリ酢酸ビニル樹脂、アクリル樹脂、ポリエステル樹脂、ポリビニルホルマール樹脂、ポリビニルブチラール樹脂、ポリスチレン樹脂、ポリカーボネート樹脂、ポリブチルメタクリレート樹脂、ポリ塩化ビニリデン樹脂、エチルセルロース樹脂、シリコーン樹脂、エポキシ樹脂、フェノール樹脂、メラミン樹脂、塩化ビニル－酢酸ビニル共重合体樹脂、塩化ビニル－アクリル共重合体樹脂、塩化ビニル－エチレン共重合体樹脂、アクリル－スチレン共重合体樹脂、スチレン－ブタジエン共重合体樹脂、エチレン－酢酸ビニル共重合体樹脂等ポリビニルアセタール樹脂、スチレン樹脂、スチレン－ブタジエン共重合体樹脂が挙げられるが、電荷輸送性物質がバインダー樹脂としての作用を有する場合にはバインダー樹脂の使用は必要がない。使用するバインダー樹脂は、分子量が大きくなると塗布特性が劣化するので、平均分子量が１，０００～１００，０００のものを使用することが好ましい。

バインダー樹脂は、電荷輸送性物質１重量部に対して０．０５～１重量部の割合で使用することが望ましい。電荷輸送層は乾燥後膜厚として１～５０μｍであり、好ましくは５～３０μｍとするとよい。

また、電荷輸送層には、電荷発生層の項で記載した電子受容性物質を同様に電荷輸送性物質１モルに対して電子受容物質を０．０００１～１０モルの割合で、配合することができる。電荷輸送層は、電荷輸送性物質、バインダー樹脂、電子受容物質を電荷発生層の項で記載したと同様の溶剤に溶解、または分散させ、同

様の塗布法により電荷発生層上への塗布、乾燥工程を経て、乾燥後膜厚１～５０μｍに形成される。

とくに、本発明の光センサにおいては、電荷発生性物質と電荷輸送性物質の相互作用によって光センサにおいて感度を高くしている。電荷発生効率を高めるためには、電荷輸送層におけるバインダー樹脂の割合を少なくすることが有効であるが、バインダー樹脂の量が少なくなると、電荷輸送層として平滑な層を形成することが困難となり、また光キャリアの発生効率が電荷発生層と電荷輸送層の界面の状態で変化するので、界面が平滑でないと高性能な光センサを得ることができない。

本発明は、電荷発生層中に電荷輸送層に含まれる電荷輸送性物質を混合することにより、光センサが高感度化することを見いだしたものである。電荷発生層中に混合する電荷輸送性物質の量は、電荷発生性物質に対してモル比で０．０１～１０であることが好ましく、０．１～１であることがとくに好ましく、０．０１以下であると添加の効果が得られず、１０以上である場合には、暗電流が小さく、本発明の情報記録方法に適さないので好ましくない。

また、電荷発生層中に混合する電荷輸送性物質は、電荷発生層に積層する電荷輸送層に使用する電荷輸送性物質と同一の電荷輸送性物質を使用しても良いし、あるいはこれらとは異なる電荷輸送性物質を用いても良い。

電極１２は、後述する情報記録媒体が不透明であれば透明性を有することが必要であるが、情報記録媒体が透明性を有する場合には透明、不透明いずれでもよく、５０～１０４Ω／cm^2 の表面抵抗率を安定して与える材料、例えば亜鉛、チタン、銅、鉄、錫等の金属薄膜導電膜、酸化錫、酸化インジウム、酸化亜鉛、酸化チタン、酸化タングステン、酸化バナジウム等の無機金属酸化物導電膜、四級アンモニウム塩等の有機導電膜等であり、単独か或いは二種以上の複合材料として用いられる。なかでも酸化物半導体が好ましく、特に酸化インジウム酸化錫複合酸化物（ＩＴＯ）が好ましい。

電極１２は蒸着、スパッタリング、ＣＶＤ、コーティング、メッキ、ディッピング、電解重合等の方法により形成される。またその膜厚は電極を構成する材料の電気特性、および情報記録の際の印加電圧により変化させる必要があるが、例

えばＩＴＯ膜では１０～３００ｎｍ程度であり、情報記録層との間の全面、或いは光導電層の形成パターンに合わせて形成される。

基板１１は、後述する情報記録媒体が不透明であれば透明性を有することが必要であるが、情報記録媒体が透明性を有する場合には透明、不透明いずれでもよく、カード、フィルム、テープ、ディスク等の形状を有し、光センサを強度的に支持するものである。光センサ自体が支持性を有する場合には設ける必要がないが、光センサを支持することができるある程度の強度を有していれば、その材質、厚みは特に制限がない。例えば可撓性のあるプラスチックフィルム、或いはガラス、ポリエステル、ポリカーボネート等のプラスチックシート、カード等の剛体が使用される。

なお、基板の電極１２が設けられる面の他方の面には、電極１２が透明であれば必要に応じて反射防止効果を有する層を積層するか、また反射防止効果を発現しうる膜厚に透明基板を調整するか、更に両者を組み合わせることにより反射防止性を付与するとよい。

次に、本発明の情報記録方法について説明する。図７は、本発明の方法に使用する情報記録装置を説明する断面図である。光センサ１０と情報記録媒体２０がスペーサ１６を介して対向配置し積層して構成される。

情報記録媒体２０について説明する。まず、本発明における情報記録媒体としては、その情報記録層が高分子－液晶複合体とする場合が挙げられる。

高分子－液晶複合体は樹脂相と液晶相からなり、液晶相中に樹脂粒子が分散した構造を有しているが、液晶材料は、スメクチック液晶、ネマチック液晶、コレステリック液晶あるいはこれらの混合物を使用することができる。液晶としては、その配向性を保持し、情報を永続的に保持させるのでメモリー性の観点から、スメクチック液晶を使用するのが好ましい。

スメクチック液晶としては、液晶性を呈する物質の末端基の炭素鎖が長いシアノビフェニル系、シアノターフェニル系、フェニルエステル系、更に弗素系等のスメクチックＡ相を呈する液晶物質、強誘電性液晶として用いられるスメクチックＣ相を呈する液晶物質、或いはスメクチックＨ、Ｇ、Ｅ、Ｆ等を呈する液晶物質等が挙げられる。

又、ネマチック液晶を使用してもよく、スメクチック或いはコレステリック液晶と混合することによりメモリー性を向上させることができ、例えば、シッフ塩基系、アゾキシ系、アゾ系、安息香酸フェニルエステル系、シクロヘキシル酸フェニルエステル系、ビフェニル系、ターフェニル系、フェニルシクロヘキサン系、フェニルピリジン系、フェニルオキサジン系、多環エタン系、フェニルシクロヘキセン系、シクロヘキシルピリミジン系、フェニル系、トラン系等の公知のネマチック液晶を使用できる。又、ポリビニルアルコール等と液晶材料を混合してマイクロカプセル化したものも使用できる。なお、液晶材料を選ぶ際には、屈折率の異方向性の大きい材料の方がコントラストがとれるので好ましい。

樹脂粒子を形成する材料としては、例えば、紫外線硬化型樹脂であって、モノマー、オリゴマーの状態で液晶材料と相溶性を有するもの、或いはモノマー、オリゴマーの状態で液晶材料と共通の溶媒に相溶性を有するものを好ましく使用できる。このような紫外線硬化型樹脂としては、例えばアクリル酸エステル、メタクリル酸エステル等が挙げられ、モノマー、オリゴマーの状態で、例えばジペンタエリスリトールヘキサアクリレート、トリメチロールプロパントリアクリレート、ポリエチレングリコールジアクリレート、ポリプロピレングリコールジアクリレート、イソシアヌール酸（エチレンオキサイド変性）トリアクリレート、ジペンタエリスリトールペンタアクリレート、ジペンタエリスリトールテトラアクリレート、ネオペンチルグリコールジアクリレート、ヘキサンジオールジアクリレート等の多官能性モノマー或いは多官能性ウレタン系、エステル系オリゴマー、更にノニルフェノール変性アクリレート、N－ビニル－２－ピロリドン、２－ヒドロキシ－３－フェノキシプロピルアクリレート等の単官能性モノマー或いはオリゴマー等が挙げられる。

溶媒としては、使用材料に共通の溶媒であれば特に問題はなく、例えばキシレン等に代表される炭化水素系溶媒、クロロホルム等に代表されるハロゲン化炭化水素系溶媒、メチルセロソルブ等に代表されるアルコール誘導体系溶媒、ジオキサン等に代表されるエーテル系溶媒等が挙げられる。

紫外線硬化型樹脂を硬化させる光硬化剤としては、例えば２－ヒドロキシ－２－メチル－１－フェニルプロパン－１－オン（メルク社製　ダロキュア１１７３

）、１－ヒドロキシシクロヘキシルフェニルケトン（チバ・ガイギー社製　イルガキュア１８４）、１－（４－イソプロピルフェニル）－２－ヒドロキシ－２－メチルプロパン－１－オン（メルク社製　ダロキュア１１１６）、ベンジルジメチルケタール（チバ・ガイギー社製　イルガキュア６５１）、２－メチル－１－〔４－（メチルチオ）フェニル〕－２－モルホリノプロパノン－１（チバ・ガイギー社製　イルガキュア９０７）、２，４－ジエチルチオキサントン（日本化薬社製　カヤキュアＤＥＴＸ）とｐ－ジメチルアミノ安息香酸エチル（日本化薬社製カヤキュアＥＰＡ）との混合物、イソプロピルチオキサントン（ワードブレキンソップ社製　クンタキュア・ＩＴＸ）とｐ－ジメチルアミノ安息香酸エチルとの混合物等が挙げられるが、液状である２－ヒドロキシ－２－メチル－１－フェニルプロパン－１－オンが液晶材料、重合体形成性モノマー若しくはオリゴマーとの相溶性の面で特に好ましい。

液晶材料と樹脂の使用割合は、液晶の含有量が１０～９０重量％、好ましくは４０～８０重量％となるように使用するとよく、１０重量％未満であると情報記録により液晶相が配向しても光透過性が低く、また、９０重量％を越えると液晶の滲み出し等の現象が生じ、画像ムラが生じ好ましくない。液晶は情報記録相中に多く存在させることにより、コントラスト比を向上させ、動作電圧を低くすることができる。

情報記録層の形成方法は、樹脂形成用材料と液晶、光硬化剤等を溶媒に溶解または分散させた混合溶液を、電極上にブレードコーター、ロールコーター、或いはスピンコーター等の塗布方法により塗布し、光または熱により樹脂形成用材料を硬化させることにより形成される。なお、必要に応じて、溶液の塗布適性を向上させ、表面性を良くするためにレベリング剤を添加してもよい。

情報記録層形成にあたっては、樹脂形成用材料と液晶との混合液が等方相を保持する温度以上に混合溶液を加熱し、液晶と紫外線硬化型樹脂形成材料とを完全に相溶させることが必要であり、これにより、樹脂相と液晶相とが均一に分散した情報記録層とすることができる。液晶が等方相を示す温度以下で紫外線硬化させると、液晶と紫外線硬化型樹脂材料との相分離が大きくなるという問題が生じる。すなわち、液晶ドメインが成長しすぎ、情報記録層表面にスキン層が完全に

形成されず、液晶の滲み出し現象が生じたり、また紫外線硬化型樹脂がマット化し、正確に情報を取り込むことが困難となり、好ましくなく、紫外線硬化型樹脂が液晶を保持できず、情報記録層を形成されないことすらある。他方、溶媒を蒸発させる際に、等方相を保持するために加熱が必要な場合には、特に電極に対する濡れ性が低下し、均一な情報記録層が得られないという問題がある。

電極に対する濡れ性を維持するとともに樹脂の表面に被膜を形成することを目的として、情報記録層に弗素系界面活性剤を添加するとよい。このような弗素系界面活性剤としては、例えば住友スリーエム（株）製、フロラードＦＣ－４３０、同フロラードＦＣ－４３１、Ｎ－（ｎ－プロピル）－Ｎ－（β－アクリロキシエチル）－パーフルオロオクチルスルホン酸アミド（三菱マテリアル（株）製ＥＦ－１２５Ｍ）、Ｎ－（ｎ－プロピル）－Ｎ－（β－メタクリロキシエチル）－パーフルオロオクチルスルホン酸アミド（三菱マテリアル（株）製ＥＦ－１３５Ｍ）、パーフルオロオクタンスルホン酸（三菱マテリアル（株）製ＥＦ－１０１）、パーフルオロカプリル酸（三菱マテリアル（株）製ＥＦ－２０１）、Ｎ－（ｎ－プロピル）－Ｎ－パーフルオロオクタンスルホン酸アミドエタノール（三菱マテリアル（株）製ＥＦ－１２１）、更に三菱マテリアル（株）製ＥＦ－１０２、同ＥＦ－１０３、同ＥＦ－１０４、同ＥＦ－１０５、同ＥＦ－１１２、同ＥＦ－１２１、同ＥＦ－１２２Ａ、同ＥＦ－１２２Ｂ、同ＥＦ－１２２Ｃ、同ＥＦ－１２２Ａ３、同ＥＦ－１２３Ａ、同ＥＦ－１２３Ｂ、同ＥＦ－１３２、同ＥＦ－３０１、同ＥＦ－３０３、同ＥＦ－３０５、同ＥＦ－３０６Ａ、同ＥＦ－５０１、同ＥＦ－７００、同ＥＦ－２０１、同ＥＦ－２０４、同ＥＦ－３５１、同ＥＦ－３５２、同ＥＦ－８０１、同ＥＦ－８０２、同ＥＦ－１２５ＤＳ、同ＥＦ－１２００、同ＥＦ－Ｌ１０２、同ＥＦ－Ｌ１５５、同ＥＦ－Ｌ１７４、同ＥＦ－Ｌ２１５等が挙げられる。また、３－（２－パーフルオロヘキシル）エトキシ－１，２－ジヒドロキシプロパン（三菱マテリアル（株）製ＭＦ－１００）、Ｎ－ｎ－プロピル－Ｎ－２，３－ジヒドロキシプロピルパーフルオロオクチルスルホンアミド（三菱マテリアル（株）製ＭＦ－１１０）、３－（２－パーフルオロヘキシル）エトキシ－１，２－エポキシプロパン（三菱マテリアル（株）製ＭＦ－１２０）、Ｎ－ｎ－プロピル－Ｎ－２，３－エポキシプロピルパーフルオロオクチ

ルスルホンアミド（三菱マテリアル（株）製ＭＦ－１３０）、パーフルオロヘキシルエチレン（三菱マテリアル（株）製ＭＦ－１４０）、Ｎ－（３－トリメトキシシリル）プロピル）パーフルオロヘプチルカルボン酸アミド（三菱マテリアル（株）製ＭＦ－１５０）、Ｎ－（３－トリメトキシシリル）プロピル）パーフルオロヘプチルスルホンアミド（三菱マテリアル（株）製ＭＦ－１６０）等が挙げられる。弗素系界面活性剤は、液晶と樹脂形成材料との合計量に対して０．１～２０重量％の割合で添加される。

また、情報記録層形成における塗布溶液における固形分濃度は１０～６０重量％とするとよく、硬化に際して、樹脂の種類、濃度、塗布層温度、また紫外線照射条件等の硬化条件を適宜に設定することにより、外表皮層として液晶相を有しない樹脂層のみからなるスキン層を良好に形成させることができ、これにより情報記録層における液晶の使用割合を増大することができ、また液晶の滲み出しを無くすることができる。

以上、樹脂材料として紫外線硬化型樹脂について説明したが、その他、液晶材料と共通の溶媒に相溶性を有する溶媒可溶型の熱硬化性樹脂、例えばアクリル樹脂、メタクリル樹脂、ポリエステル樹脂、ポリスチレン樹脂、及びこれらを主体とした共重合体等、エポキシ樹脂、シリコーン樹脂等を使用してもよい。

情報記録層の膜厚は解像性に影響を与えるので、乾燥後膜厚０．１～１０μｍ、好ましくは3～8μｍとするとよく、高解像性を維持しつつ、動作電圧も低くすることができる。膜厚が薄すぎると情報記録部のコントラストが低く、また、厚すぎると動作電圧が高くなるので好ましくない。

なお、情報記録層がそれ自体支持性を有し、支持体を省略する場合には、情報記録層の表面にはスキン層が形成されているので、例えばＩＴＯ膜を蒸着法、スパッタ法等により積層してもひび割れが生じなく、導電性の低下のないものとできる。この場合、仮支持体上に設けた情報記録層上に電極を設けた後、仮支持体を剥離して情報記録媒体とするとよい。

情報記録媒体の基板２１上に電極２２が積層され、電極上には情報記録層２３が形成されている。電極２２は、上述の光センサにおける電極１２と同様の材料、及び同様の積層方法で基板２１上に設けられる。

この情報記録媒体は、図７に示すように上述した光センサとスペーサー１６を介して、対向配置し、両電極１２、２２を電圧源Ｖを介して結線して第１の情報記録装置とされる。この装置における電極１２、２２は、いずれか一方、または両方が透明であればよい。

スペーサーとしては、ポリエチレンテレフタレート等のポリエステル、ポリイミド、ポリエチレン、ポリ塩化ビニル、ポリ塩化ビニリデン、ポリアクリロニトリル、ポリアミド、ポリプロピレン、酢酸セルロース、エチルセルロース、ポリカーボネート、ポリスチレン、ポリテトラフルオロエチレン等の樹脂フィルムを使用して形成するとよく、また、上記各樹脂溶液を塗布、乾燥させて形成してもよい。また、アルミニウム、セレン、テルル、金、白金等の金属材料又は無機或いは有機化合物を蒸着して形成してもよい。スペーサーの膜厚は、光センサと情報記録媒体との空隙距離となり、情報記録層に印加される電圧配分に影響を与えるので、少なくとも１００μｍ以下とするとよく、好ましくは３～３０μｍとするとよい。

また、本発明の情報記録装置は、光センサと情報記録媒体を間隙を設けて配置する以外に、光センサと情報記録媒体とを直接積層するか、あるいは光センサの光導電層上に絶縁性の誘電体層を形成した後に、情報記録層および上部電極を形成した一体型にしても良い。

誘電体層を形成する材料としては、無機材料では SiO_2 、TiO_2、CeO_2、Al_2O_3 、GeO_2、Si_3N_4 、AlN 、TiN 等を使用し、蒸着法、スパッタ法、化学蒸着（ＣＶＤ）法等により積層して形成するとよい。また、有機溶剤に対して相溶性の少ない水溶性樹脂、例えばポリビニルアルコール、水系ポリウレタン、水ガラス等の水溶液を使用し、スピンコート法、ブレードコート法、ロールコート法等により積層してもよい。更に、塗布可能なフッ素樹脂を使用してもよく、この場合にはフッ素系溶剤に溶解し、スピンコート法により塗布するか、またブレードコート法、ロールコート法等により積層してもよい。

塗布可能なフッ素樹脂としては、例えば特開平１－１３１２１５号公報等に開示されたフッ素樹脂、更に真空系で膜形成されるポリパラキシリレン等の有機材料を好ましく使用することができる。

次に、本発明の情報記録装置への情報記録方法について、光センサと情報記録媒体を間隙を設けて配置する例について説明する。図８は、本発明の光センサを使用した情報記録方法を説明する図である。

情報光によって露光の後に、電極１２、２２間に電圧を印加、情報光１７による露光とともに印加電圧を断続的に供給、あるいは電圧の印加を停止した後に再度電圧を印加する等の電圧の印加を制御する制御装置１８を有しており、光が入射した部分の電荷発生層１４、電荷輸送層１５からなる光導電層で発生した光キャリアは、両電極により形成される電界により移動し、電圧の再配分が行われ、情報記録層における液晶相が配向し、情報光１７のパターンに応じた記録が行なわれる。なお、情報光１７を入射しつつ、電圧を所定時間印加してもよい。

また、液晶によって動作電圧及び範囲が異なるものもあるので、印加電圧及び印加電圧時間を設定するにあたっては、情報記録媒体における電圧配分を適宜設定し、情報記録層にかかる電圧配分を液晶の動作電圧領域に設定するとよい。この情報記録方法は、面状アナログ記録が可能であり、液晶レベルでの記録が得られるので、高解像度の記録となり、また露光パターンは液晶相の配向により可視像化されて保持される。

情報記録方法としては、カメラによる方法、またレーザーによる記録方法がある。カメラによる方法としては、通常のカメラに使用されている写真フィルムの代わりに情報記録媒体が使用され、記録部材とするもので、光学的なシャッタも使用しうるし、また電気的なシャッタも使用しうるものである。また、プリズム及びカラーフィルターにより光情報を、Ｒ、Ｇ、Ｂ光成分に分離し、平行光として取り出しＲ、Ｇ、Ｂの各色用の３個の情報記録媒体で１コマを形成するか、または１個の情報記録媒体の異なる部分にＲ、Ｇ、Ｂの各画像を記録して１コマとすることにより、カラー撮影することもできる。

また、レーザーによる記録方法としては、光源としてはアルゴンレーザー（５１４．４８８ｎｍ）、ヘリウム－ネオンレーザー（６３３ｎｍ）、半導体レーザー（７８０ｎｍ、８１０ｎｍ等）が使用でき、画像信号、文字信号、コード信号、線画信号に対応したレーザー露光をスキャニングにより行うものである。画像のようなアナログ的な記録は、レーザーの光強度を変調して行い、文字、コード

、線画のようなデジタル的な記録は、レーザー光のＯＮ－ＯＦＦ制御により行う。また画像において網点形成されるものには、レーザー光にドットジェネレーターにＯＮ－ＯＦＦ制御を行って形成するものである。

情報記録媒体に記録された露光情報は、情報記録媒体を分離し、透過光により情報を再生すると、情報記録部では液晶が電界方向に配向するために光は透過するのに対して、情報を記録していない部位においては光は散乱し、情報記録部とのコントラストがとれる。また、これらの情報記録装置で記録された情報は、反射光により読み取ってもよい。

液晶の配向により記録された情報は、目視による読み取りが可能な可視情報であるが、投影機により拡大して読み取ることもでき、レーザースキャニング、或いはＣＣＤを用いて透過光、または反射光により高精度で情報を読み取ることができ、必要に応じてシュリーレン光学系を用いることにより散乱光を防ぐことができる。

本発明の情報記録装置における情報記録媒体は、静電情報を液晶の配向により可視化した状態で記録するものであるが、液晶と樹脂との組合せを選ぶことにより、一度配向し可視化した情報は消去せず、メモリ性が付与される。また、等方相転移付近の高温に加熱すると、メモリー性を消去することができるので、再度の情報記録に使用することができる。

本発明の光センサは、上述のように高分子ー液晶複合体を情報記録層とする情報記録媒体への情報記録に適しているが、他の情報記録媒体、例えば特開平４－７０８４２号公報、特開平４－４６３４７号公報、特開平３－７９４２号公報、特開平４－７３７６９号公報等に記載された、弗素樹脂等の電荷保持性に優れた絶縁性樹脂層を情報記録層とする静電情報記録媒体であって、情報を静電荷の形で蓄積し、トナー現像されるか、電位読み取りにより静電情報を再生することができる情報記録媒体や、また特開平３－１７０９８５号公報、特開平３－１７０９８４号公報、特開平３－１９２２８８号公報等に記載された、熱可塑性樹脂層を情報記録層とする情報記録媒体であって、上記同様に情報を静電荷の形で表面に蓄積した後、加熱されることにより、情報をフロスト像として蓄積し、可視情報として情報再生することが可能な情報記録媒体に対する情報記録にも使用でき

る。

また、本発明の光センサは作製したままの状態では、本発明の特徴である半導電性を有さないため、本発明で使用することはできない。本発明で使用するためには、所定時間以上に放置することにより、暗所においても所定の半導電性を示すセンサーとなる。また、光センサとしての使用前に十分な露光量の光を全面に一様露光した後使用しても良い。

本発明の光センサは、露光強度が低い場合でも、電圧印加と露光の開始時点を変化させることにより、コントラストの充分な情報を記録することができる。また電圧印加と露光の開始時点により液晶記録層に印加される電位差が最大になる時間も異なるため、それぞれに応じて最適な印加電圧と電圧印加時間で情報記録を行うことができる。

また、本発明の光センサは、露光後もしくは露光と同時に電圧印加した後に電圧印加を停止し、再び電圧印加を行うか、逆極性の電圧を印加後に再び電圧を印加することにより露光部と未露光部で導電性に差が生じる。また、電圧印加を停止しているかもしくは逆極性の電圧を印加している間に、露光することにより再び電圧印加した際には、電圧印加をし続けた場合と同様に、露光部分の導電性が高くなっている。

また、電圧印加を複数回行うことによりコントラストの大きな画像情報を記録することができる。1回目の電圧印加露光により、未露光部分の液晶記録媒体の電圧がしきい値になり、配向を開始した直後に電圧印加を停止するか、最初に印加した電圧より低い電圧または逆極性の電圧を印加することにより、液晶記録層の電圧を低くすることができる。この状態でしばらく経過した後に再び電圧印加し、未露光部の電圧がしきい値になるまで、電圧印加を続ける。電圧印加を停止した状態または逆極性の電圧が印加されている状態では、光センサには逆極性の電圧が印加される場合もあるが、再び電圧が印加されることにより、未露光部分と露光部分の導電性に違いが生じるため、液晶記録層の露光部分により多くの電圧が印加されることになり情報記録をすることができる。

繰り返し電圧印加した場合の液晶記録層および光センサに印加される電圧の変化の一例を図9に示す。ここでは、液晶記録媒体と光センサは空気層を介して対

向配置した例を示したが、光センサと液晶記録媒体は直接もしくは誘電体層を介して積層したものであっても同様の電圧印加方法によって情報記録を行うことができる。

また、光センサに2種類以上の画像情報を多重露光して記録する方法について示す。図10は、2つの画像情報を記録する方法について示す。電圧印加する前に、1つの画像情報をt1の期間露光し、もう一つの画像情報をt2の期間露光すると同時にt3の期間電圧印加し情報記録を行う。このような方法で2種類以上の画像情報、例えば絵と文字とを重ね合わせて1枚の画像として記録することができる。このように画像情報は液晶記録媒体の同じ場所に重ね合わせて記録することもできるし、それぞれの画像情報を別々の場所に記録することもできる。

一度の電圧印加で複数の画像情報を記録することで、2回目以降の画像を記録する際に、それ以前に記録した画像情報を乱すことなしに画像情報の記録を行うことができる。重ね合わせる画像情報の数に制限はないが、最初の画像情報を露光してからあまり長い間経過してから電圧印加をすると、画像情報が消滅していることがあるので、比較的短時間で画像記録を行う必要がある。

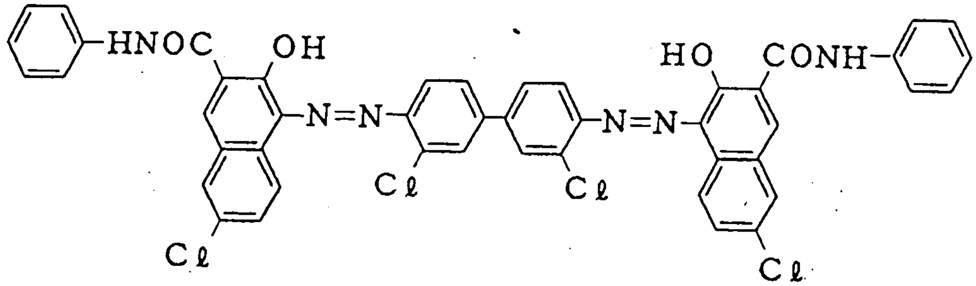
また、画像情報は時間とともに減衰するため、各画像情報を等しい強度で記録するためには、露光時間を調整する等の工夫が必要である。

レーザーで記録する場合には、光センサにレーザー光を走査することにより画像や文字の情報を記録することができる。光センサと液晶記録媒体を対向配置した状態でレーザー光を走査することにより、光センサ上に画像や文字情報を描画し、描画終了後、光センサと液晶記録媒体には両電極間に電圧を印加することにより画像記録をすることができる。液晶記録媒体には、レーザー光を用いて熱により書き込むことができるが、熱による書き込みでは熱の拡散により高解像度の描画ができない問題があるが、このように光りセンサーに描画し、電圧印加して記録することにより高解像度の画像を記録することができる。

〔実施例1〕

充分洗浄した厚さ1．1mmのガラス基板上に、膜厚100nmのITO膜をスパッタリングにより成膜し電極層を得た。

その電極上に、下記構造を有するビスアゾ顔料３重量部、塩化ビニル－酢酸ビニル共重合体０．７５重量部、ポリ酢酸ビニル０．２５重量部、１．４－ジオキサン９８重量部、シクロヘキサノン９８重量部を混合しペイントシェーカーで６時間分散して塗布液とし、スピンナーにて１４００ｒｐｍ、０．４秒で塗布した後、１００℃、１時間乾燥して、膜厚３００ｎｍの電荷発生層を積層した。



この電荷発生層上に、電荷輸送性物質として下記構造の化合物を１重量部、ポリスチレン樹脂を４重量部、１、１、２－トリクロロメタン２２重量部、ジクロロメタン１４重量部を混合した塗布液を、スピンナーにて４００ｒｐｍ、０．４秒間で塗布した後８０℃、２時間乾燥して電荷輸送層を積層し、電荷発生層と電荷輸送層からなる膜厚２０μｍの光導電層を有する光センサを得た。得られた光センサは作製後、相対湿度６０％以下の暗所下に３日間エージングしたのちに使用した。

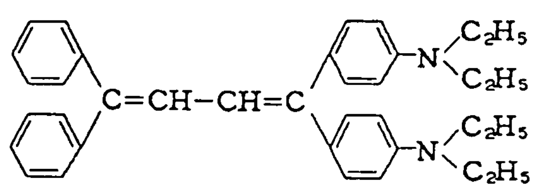


図１１に、本発明の光センサの特性の測定方法を示す。光センサ１０は基板１１上に透明電極１２を有し、透明電極上には電荷発生層と電荷輸送層からなる光

導電層１３を有し、光導電層上には金電極３１を０．１６cm^{2}の大きさで形成している。光源３２からフィルター３３を透過した緑色光はパルス発生装置３４によって開閉を制御されるシャッター３５から光センサ１０を照射する。また、パルス発生装置は金電極３１と透明電極間１２に直流電流を透明電極側が正になるように印加する電源３６の電圧および電圧印加時間を制御する。また、金電極側に結合した抵抗から電圧を取り出してオシロスコープ３７によって光誘起電流を測定した。

露光強度２０ｌｕｘ、露光時間３３ｍ秒とし、露光開始と同時に２００Ｖの電圧を印加した場合の光センサに流れる電流Ｌ１（明電流）と、露光しない場合の電流Ｌ２（暗電流）を図１２に示し、明電流と暗電流との差で表される光誘起電流を図１３に示す。光誘起電流は露光中は増加し、露光終了後も電圧印加中は緩やかに減衰し、充分長い時間流れ続ける。

次に、電圧印加と露光の開始時点をずらした場合に、明電流と暗電流を測定した結果を図１４に示す。露光時間、露光強度は図１２の場合と同様に、２０ｌｕｘ、３３ｍ秒間で、電圧印加は露光終了と同時に行い、２００Ｖの電圧を印加した。電圧印加開始前に、露光を終了した場合には、露光部分と未露光部分で導電性に違いがあることがわかる。

以上の２種類の電圧印加露光方法での電流測定したときの光誘起電流の測定結果を図１５に示す。２０ｌｕｘの光を３３ｍ秒間露光し、一方は露光開始と同時に、２００Ｖの電圧を印加し（Ａ）、他方は露光終了と同時に２００Ｖの電圧を印加した（Ｂ）。明電流と暗電流の差で表される光誘起電流は、露光と電圧印加の時点には関係なく、露光時間に依存し、電圧印加されている状態ではほぼ等しくなる。電圧印加開始は、露光開始と同時あるいは露光終了直後に行う必要はなく、露光中あるいは露光終了後しばらく時間が経過した後に電圧を印加しても同様の結果が得られる。

また、この例では光誘起電流の値がほぼ等しくなる場合を示したが、必ずしも光誘起電流が等しくなる場合のみではなく、露光と電圧印加時点により光誘起電流が異なる場合もあるが、このような場合でも光照射終了後、電圧印加したときに、未露光部に対して露光部の導電性が高くなる光センサは本発明の情報記録方

法に使用することができる。

〔実施例２〕

電圧印加方法を以下のように変えた以外は実施例１と同様に光センサの特性を測定した。

２００Ｖの一定電圧を印加した場合と、２００Ｖの矩形波電圧を印加した状態で２０ｌｕｘ、３３ｍ秒の光で露光した場合の電流の測定結果を図１６に示す。矩形波は、５０ｍ秒間の電圧の印加の後に５０ｍ秒間電圧の印加を停止した後に再び電圧を印加することを繰り返し行った。

一定電圧を印加した場合の電流を破線で示し、矩形波の電圧を印加した場合の電流を実線で示した。

電圧が印加されていない状態では、電流は流れないが、２００Ｖの電圧を印加した場合には、一定電圧を印加した場合も、矩形波のパルス状の電圧を印加した場合も電流はほぼ等しくなり、電圧印加を停止し、再び電圧を印加したときにも２００Ｖの電圧を印加し続けた場合とほぼ等しい電流値を示す。

また、上記例では、パルス状の電圧を印加している間は電圧０である場合を示したが、パルス状の電圧を印加している間に逆極性の電圧を印加する場合でも、上記と同様に２００Ｖの電圧が印加されている状態では、一定電圧を印加したときと等しい電流値になり、逆極性の電圧が印加されている状態では、逆極性の電流が流れ、このときは露光部分と未露光部分の導電性に違いはみられない。

以上のように、一定電圧を印加した場合とパルス状の電圧を印加した場合と測定される電流がほぼ等しくなる場合に限らず、露光中、露光終了後を問わず、露光部分と未露光部分の導電性が異なり、未露光部分に比べて露光部分の導電性が高くなっているような光センサは本発明の情報記録方法に使用することができる。

〔実施例３〕

露光強度を１２ｌｕｘ、露光時間を５００ｍ秒間とし、実施例２と同様に２００Ｖの一定電圧を連続的に印加した場合を破線で、５０ｍ秒間印加した後に５０ｍ秒間印加しない矩形波電圧を印加した場合を実線でそれぞれ図１７に示す。一定電圧を印加した状態では露光中は光誘起電流が増加することは、これまでの実

施例と同様であるが、矩形波電圧をパルス状に印加した場合には、印加電圧が0Vの期間も露光中は光誘起電流が増加していることを示している。

〔実施例4〕

液晶記録媒体を情報記録媒体としたときの、光センサの情報記録性能を求めた。液晶記録媒体は図18に表すように、抵抗（R_{LC}）とコンデンサ（C_{LC}）の並列回路とし表現することができ、光センサも抵抗（R_{PS}）とコンデンサ（C_{PS}）の並列回路として表現することができる。光センサの膜厚10μm、液晶記録媒体の1cm^2当りの容量：1000pF、電気抵抗：120MΩ、光センサと液晶記録媒体との間隔を10μm、光センサ側の電極と液晶記録媒体側の電極の間の印加電圧を730Vとし、20lux、1／30秒間露光した場合の測定結果から求めた結果を図19に示す。

電圧印加直後は、電圧は、光センサと液晶記録媒体の容量の比に分配される。その後、光センサと液晶記録媒体の抵抗成分により電圧の分配が変化し、液晶記録媒体の電圧が増加する。露光部分と未露光部分では光センサの導電性が異なるため、未露光部分に比べて露光部分では液晶記録媒体により多くの電圧が印加されることとなる。

液晶記録媒体は、しきい値電圧以上になると、液晶が電界方向に配向し、透過率が増加する。その結果、未露光部分に比べて露光部分では液晶記録媒体の電圧が早くしきい値電圧に達するため、未露光部分の電圧がしきい値に到達し、配向を開始したときに電圧印加を停止すると、すでにしきい値以上の電圧が印加されて配向をした露光部分と未露光部分の透過率が異なり、電圧印加を停止した後もこの状態が維持されるために情報を記録することができる。

〔実施例5〕

6luxの強度の光を200m秒間露光した後に、露光終了と同時に200Vの電圧を印加した点を除いて実施例2と同様に、明電流と暗電流の差である光誘起電流を測定し、その結果を図20に示す。また、液晶記録媒体への情報記録に有効な電圧印加開始後50m秒間の光誘起電流を斜線で示す。

〔実施例6〕

6luxの強度の光を200m秒間露光し、露光開始後150m秒後に200

Ｖの電圧を印加した点を除いて実施例５と同様に、明電流と暗電流の差である光誘起電流を測定し、その結果を図２１に示す。また、液晶記録媒体への情報記録に有効な電圧印加開始後５０ｍ秒間の光誘起電流を斜線で示す。

〔比較例１〕

６１ｕｘの強度の光を２００ｍ秒間露光し、露光と同時に２００Ｖの電圧を印加した点を除いて実施例５と同様に、明電流と暗電流の差である光誘起電流を測定し、その結果を図２２に示す。また、液晶記録媒体への情報記録に有効な電圧印加開始後５０ｍ秒間の光誘起電流を斜線で示す。

長時間の露光によって２０１ｕｘの光を３３ｍ秒間露光した場合と同等の光誘起電流を得ることができるが、電圧印加開始後５０ｍ秒間の光誘起電流を斜線で示すように斜線の部分の面積が、２０１ｕｘの光を露光した場合や実施例５あるいは６に比べて少なく、充分なコントラストの画像の情報記録ができないことを示している。

〔実施例７〕

実施例４と同様に液晶記録媒体に印加される電圧を計算し、露光部と未露光部に電圧の差をシミュレーションした結果を図２３に示す。図において、ａは２０１ｕｘ、３３ｍ秒間露光し、露光と同時に電圧を印加した場合、ｂは比較例１、ｃは実施例５、ｄは実施例６を示し、ｅは６１ｕｘで２００ｍ秒間露光した場合で、露光開始後１７５ｍ秒後に電圧印加した場合をそれぞれ示している。

液晶記録媒体のしきい値電圧を２００Ｖとすると、未露光部の液晶記録媒体の電圧は約６５ｍ秒後でしきい値電圧に達するために、この時間内に電圧印加を停止することによって情報を記録することができる。この場合の明部と暗部の電位差を比較することによって情報記録後のコントラストを推定することができる。図２３から、６５ｍ秒後における電位差を比較すると、ａに比べてｂの電位差は１／２程度であるため、大きなコントラストが得られないことがわかる。これに対して、ｃ、ｄ、ｅではａと同程度かそれ以上の電位差が得られる。また、ｄ，ｅは６５ｍ秒後には、同程度の電位差だが、ｄに比べてｅの印加電圧を高めに設定して、３０ｍ秒程度の電圧印加時間で情報記録を行うことにより、より大きなコントラストで情報記録を行うことができる。

次に、画像露光開始から電圧印加開始までの時間を変えることにより、記録画像のラチチュードを変える記録方法について説明する。

図２４は、本発明の光センサを使用し、電圧印加した状態で画像露光し、照射光強度を変化させたときの光誘起電流の測定結果を示すものである。光の照射時間は同様に３３ｍｓｅｃで測定した。露光強度は、△は４００Ｌｕｘ、＋は２００Ｌｕｘ、×は１２０Ｌｕｘ、□は８０Ｌｕｘ、○は４０Ｌｕｘ、●は２０Ｌｕｘである。

光誘起電流は光照射中増加し３３ｍｓｅｃ後に最大になる。この時の光誘起電流は光強度に依存し、光強度が強いほど光誘起電流も大きくなる。また、光照射後の減衰は、照射光強度が強いほど減衰速度が速く、照射光強度が弱い光の場合には緩やかに減衰することがわかる。このため、光照射終了後、一定時間経過したときの光誘起電流は、光照射終了直後に比べて、低露光強度における光誘起電流に対して、高露光強度における光誘起電流の割合が減少していることがわかる。

本発明の画像記録方法においては、このような光誘起電流の大きさに応じて液晶が配向するため、図２４の結果から、画像露光終了後、ある程度時間が経過した時に電圧印加すると、液晶の配向状態が低露光域と高露光域の差が小さくなることが予想できる。すなわち、ラチチュードが拡大することが予想される。

図２５はラチチュードを変えるための画像記録装置の構成を示し、本発明の光センサ１０と液晶記録媒体２０を約９ミクロンの厚さのポリイミドフィルムをスペーサにして空隙を介して対向配置した状態で画像記録装置に設置する。画像記録装置は、光源５１、レンズ５３、およびシャッタ５２を用いて透過原稿５４の透過画像を光センサ１０に露光することができる。また、画像記録装置は制御回路４０により、電源３０およびシャッタ５２を制御し、任意の時間、光センサに画像露光することができ、また、電源３０により任意の時間、両電力間に電圧印加することができる。また、電圧印加と画像露光のタイミングも任意に変化させることができる。

透過原稿は、ステップごとに光学濃度が０．１ずつ変化するグレースケールを用いた。図２６を用いて本実施例の電圧印加と画像露光のタイミングについて説

明すると、画像露光時間をt_{ex}とし、画像露光開始から電圧印加開始までの時間をt_dとする。t_dを０～１２５ｍｓｅｃの範囲で変化させ、他の条件は同じにして画像記録を行った。このときの記録条件は、露光時間１／１２５秒、印加電圧７５０Ｖ、電圧印加時間５０ｍｓｅｃである。

これらの条件で画像記録を行い、記録した液晶記録媒体２０に対して読み取り光を照射し、透過光をＣＣＤセンサで読み取って露光量（グレースケールステップ）に対して、読み取り信号をプロットした結果を図２７に示す。図２７において、○はt_d＝０、×はt_d＝１２ｍｓｅｃ、△はt_d＝２８ｍｓｅｃ、□はt_d＝５０ｍｓｅｃ、◇はt_d＝１２５ｍｓｅｃである。

図２７より画像露光と同時に電圧印加をした場合（○）では、ステップ透過濃度が０．８程度で飽和してしまいラチチュードの狭い画像となり、画像露光から電圧印加までの時間が長いほど飽和濃度が大きくなり、ラチチュードが拡大することが分かる。

このように、画像露光に対して電圧印加開始のタイミングを遅らせて画像記録することにより、ラチチュードの広い条件で画像記録を行うことができる。時間t_dは、記録する被写体の状態や目的に合わせて選択すればよい。

次に、本発明のシステムにおける画像記録の相反則不軌を補正する方法について説明する。

図１、図３で既に示したように、光センサの電流値は、露光中は、露光開始と同時に増加し、露光終了後も直ちに露光開始前の状態には戻らず、ゆっくりと減衰する。光センサの電流値は露光しない状態でも零ではなく、これをベース電流とすると、ベース電流との差が光誘起電流で、この差を利用して画像記録を行うことができる。なお、光誘起電流はベース電流に依存する性質があり、ベース電流が大きい（光センサの導電率が大きい）ほど光誘起電流も大きくなり、ベース電流が小さい（光センサの導電率が小さい）ほど光誘起電流は小さくなる。

本発明のシステムでは、このように露光終了後も光誘起電流が緩やかに減衰して流れ続けることを利用して、画像露光終了後もしばらくの間電圧印加を続けることにより、光誘起電流を有効に利用して、記録感度を高めることができる。

また、図１５で説明したように、電圧印加した状態で画像露光した場合（図の

Ａ）、画像露光後に電圧印加した場合（図のＢ）、電圧印加開始後は同じように光誘起電流が流れることが分かる。これは、電圧印加しなくても、露光することにより、光センサには電流を流れ易くする（抵抗値を低くする）前駆体が生成されているためであると考えられる。

次に、露光時間を極端に長く（１秒）した場合の光誘起電流の測定結果を図２８に示す。図示するように、露光開始直後は直線的に光誘起電流が増加するが、２００ｍｓｅｃ付近から光誘起電流の増加量が急速に減衰し、約１秒後にほぼ飽和値に達している。図２８の傾向は、前駆体についても同様である。

次に、相反則、相反則不軌の測定について説明する。

図２５に示す光学系と画像露光装置を用いて相反則・不軌を測定した。なお、光センサへの入射光強度は、光源４０からの光をＮＤフィルタ（図示せず）を通し、この透過率を変えることにより調節した。

光センサと液晶媒体は、約１０μｍのフィルムをスペーサーにして、空気ギャップを介して対向配置し、光センサに画像露光し、電源３０により、両電極間に７００Ｖ、６０ｍｓｅｃ電圧印加して画像記録を行った。電源３０は制御装置４０により制御され、画像露光に対して、任意のタイミングで電圧印加する。

このような画像露光装置を用いて露光強度と画像露光時間を変化させ、階調特性、すなわち露光量－液晶媒体透過率との関係により相反則を調べた。なお、電圧印加条件が変化すると、階調特性が変化するため、電圧印加条件は同じにして測定した。

まず初めに、通常の画像露光・電圧印加条件で相反則・不軌を調べた。通常の電圧印加条件は、図２９に示すように、電圧印加と同時に画像露光を開始し、画像露光終了後も電圧印加を継続する方法で画像記録を行った。

電圧印加時間を６０ｍｓｅｃとし、露光時間を１／４００、１／１２５、１／６０、１／３０、１／１５ｓｅｃに対して、それぞれ露光量が等しくなるように露光強度を調整して画像記録を行った。記録した画像を専用の画像読み取り装置で測定した結果を図３０に示す。図の横軸は露光量の変化量、縦軸は読み取り信号強度である。なお、図３０には、１／４００ｓｅｃ（図の○）、１／１２５ｓｅｃ（図の□）、１／３０ｓｅｃ（図の＋）のみ示した。図３０における露光時

間１／４ｓｅｃ（×印）、２．０ｓｅｃ（△印）は、後述する図３２に示すように、電圧印加時間は同じで、電圧印加開始前に露光した場合を示している。

１／１２５～１／３０ｓｅｃの範囲では、階調特性曲線が重なり、相反則が成り立っている。１／４００ｓｅｃの場合には低露光側に若干シフトしている。

また、電圧印加時間より短時間露光の場合には、露光終了後にも電圧印加を続けることにより、光誘起電流を有効に利用することができるが、１／１５ｓｅｃの場合には、図３１（ａ）に示す電圧印加・露光方法であり、露光時間と電圧印加時間とがほぼ等しいため、光誘起電流を有効に活用できないため、特性曲線が高露光側にシフトしてしまい、相反則が成り立たない（相反則不軌）。

また、１／１５ｓｅｃ以上の長い露光、すなわち図３１（ｂ）の電圧印加・露光方法の場合には、電圧印加終了後の露光が全く無駄になってしまうため、露光時間が長くなるほど特性曲線が高露光側にシフトしてしまい、この領域では相反則不軌となる。

次に、相反則不軌補正方法について説明する。

〔露光時間が長い領域の補正方法〕

まず初めに、露光時間が長い領域の補正方法について説明する。

本発明のシステムで使用する光センサは、前述したように、電圧を印加しない状態で画像露光した場合でも、後に電圧印加することにより、光誘起電流が発生する特性を有している。このことを利用して、長時間露光する場合、図３２に示すように、電圧印加前に画像露光を開始しておいて、電圧印加終了前あるいは終了と同時に画像露光を終了することにより、電圧印加開始前の光を無駄にすることがなくなる。

図３１に示したように、電圧印加開始と同時に画像露光した場合と、図３２に示すように電圧印加前に画像露光し、電圧印加と画像露光を同時に終了させた場合の記録画像の読み取り信号を較した結果を図３３に示す。画像露光時間はどちらも２秒で、電圧印加条件は、７００Ｖ、６５ｍｓｅｃで行った。図中、○は図３２による電圧印加・露光方法、×は図３１（ｂ）に示す電圧印加・露光方法の場合である。なお、この○の特性は図３０の△の特性と同じである。

図から分かるように、電圧印加と同時に露光した場合には、電圧印加終了後の

光が全く無駄になってしまうため、特性曲線が高露光側に大きくシフトし、また、画像露光を電圧印加前に開始することにより、長時間露光であっても光センサの特性曲線の高露光側へのシフトを抑えることができた。このように、電圧印加開始前に露光することにより、特性曲線の高露光側へのシフトを防ぐ、換言すれば低露光側へシフトさせることができるので、電圧印加開始前の露光時間を調整することにより、相反則不軌の補正に利用することが可能である。

〔露光時間と電圧印加時間が等しい場合の補正方法〕

本発明のシステムでは、画像露光終了後も光誘起電流は直ちに零とはならずに、緩やかに減衰しながら流れるため、画像露光終了後も電圧印加を続けることにより、光誘起電流を効率良く利用することができる。このことから、露光時間と電圧印加時間がほぼ等しい場合でも、例えば電圧印加終了後に露光していて光誘起電流の有効利用ができていない場合は、感度が低下して特性曲線が高露光側にシフトする。このようなことを防ぐため、図３４に示すように、電圧印加開始前に画像露光を開始し、画像露光終了後も電圧印加を続けるようにする。このようにすれば、露光して光誘起電流がある程度大きくなるタイミングで電圧印加を開始すれば、光誘起電流の大きい時間帯で電圧印加することができ、高感度化することができる。

図３５にこのような方法で画像記録した結果を示す。

画像記録は、露光時間１／１５秒、電圧印加時間６５ｍｓｅｃ（印加電圧７００Ｖ）で行った。露光方法Ａは、図３１（ａ）に示す方法により、電圧印加と画像露光を同時に開始した場合（図の×印）、露光方法Ｂは図３４に示す方法により、画像露光開始後、約３０ｍｓｅｃ後に電圧印加を開始した場合（図の○印）である。図から分かるように、露光方法Ｂでは、露光方法Ａに比べて特性曲線が低露光側にシフトし、光誘起電流を有効に利用している結果が得られた。

次に相反則不軌の他の補正方法について説明する。

〔シャッタ速度・絞りによる補正方法〕

補正方法の他の方法は、特性曲線のずれをあらかじめ測定しておいて、シャッタースピードや絞り値を調整することで、適正な露光量で画像記録を行う方法である。

露光時間（シャッタースピード）を変化させて（１／４００ｓｅｃ、１／２５０ｓｅｃ、１／１２５ｓｅｃ、１／６０ｓｅｃ、１／３０ｓｅｃ、１／１５ｓｅｃ、１／８ｓｅｃ、１／４ｓｅｃ、１／２ｓｅｃ、１ｓｅｃ、２ｓｅｃ）画像記録を行った。露光時間が１／８ｓｅｃ以上の長時間露光の場合には、図３２に示したように、電圧印加と画像露光を同時に終了するように電圧印加と露光のタイミングを調整し、電圧印加前に露光開始した。電圧印加時間は６５ｍｓｅｃ（未露光部の電圧がしきい値電圧に達するまでの時間）で、露光時間１／１５ｓｅｃの場合は、図３４で説明したように、光誘起電流を有効利用するため露光時間開始後３０ｍｓｅｃ後に電圧印加を開始する方法で画像記録を行った。

主な結果は図３０に示した通りである。露光時間１／２５０～１／１５ｓｅｃまでは、露光量に対する液晶媒体の透過率変化がほぼ等しくなり、この範囲で相反則が示された。１／１５ｓｅｃ以上の長時間露光では、電圧印加開始前に画像露光した場合でも、露光時間が長くなるにつれて、特性曲線が高露光側にシフトする傾向が見られた。これは図２８に示したように、露光時間が長くなると光誘起電流が直線的に変化せずに、増加量が減少するためと考えられる。しかし、シフト量は、電圧印加開始前の露光による補正で軽減されているため、約２秒露光の場合で０．４～０．５ｌｏｇ（Ｌｕｘ・ｓｅｃ）である。

また、シャッタースピードが速い場合には特性曲線が低露光域側にシフトする傾向が見られる。

これらの測定結果から、本発明のシステムでは高速および低速シャッター領域で相反則不軌でありこれを補正する必要がある。１／２５０～１／１５の広い範囲で、相反則が成り立つため、この特性に合わせるようにそれぞれ補正する必要がある。

このような測定により相反則不軌の領域と、シフト量をあらかじめ測定しておき、その値に応じて、シャッタースピードや絞り値を調整することにより、適正な露光量で画像記録をすることができる。

例えば、シャッタースピードが１／４秒の時のずれは０．２ｌｏｇ（Ｌｕｘ・ｓｅｃ）であるため、１／１２５に比べて約４０％程度余計に露光すれば良い。

画像記録装置（カメラ）の絞りやシャッタースピードは任意の値を選ぶことが

できないため、十分に適正な露光量に制御することができない場合がある。

この場合の補正方法について説明する。

〔高速シャッターの場合〕

高速シャッターの場合、特性曲線が低露光域側にシフトするため、以下のように、画像露光と電圧印加のタイミングを変えることにより、補正することができる。高速シャッターでは、低露光側にシフトするため、露光量を減らすように補正すればよい。図３６（ｂ）に示すように、電圧印加と画像露光を同時にしないで、電圧印加開始前に画像露光し、光誘起電流が減衰したところで電圧印加を開始することにより、露光量を減らしたのと同じ効果が得られる。露光のタイミングは、図３０から得られるシフト量と、光誘起電流の減衰曲線からタイミングt_dを調整すれば良い。

また、同様の方法で、t_dを変化させることにより、見かけの感度が変化するため、同じ露光条件に対して、任意に絞り値を設定することができる。例えば絞り値を開放したい場合にはt_dを長くすれば良い。

〔電圧印加条件による補正〕

高速シャッターの場合の補正方法では長時間露光の補正ができない。

本発明のシステムでは電圧印加条件により、特性曲線を変化させることができる。

図３０に示したように、同一電圧印加条件で比較した場合、シャッタースピード１／４ｓｅｃでは、１／１２５ｓｅｃに比べて０．２ｌｏｇ（Ｌｕｘ・ｓｅｃ）高露光側にシフトしている。

露光時間１／４ｓｅｃに対して、電圧印加条件を７２０Ｖ、６５ｍｓｅｃで画像記録した結果を図３７に示す。印加電圧を高めに設定したため、未露光部分の液晶媒体の透過率が増加している。図３８に、未露光部分の透過率と高露光部分の透過率の間で規格化した結果を比較すると、特性曲線が一致した。このように、電圧印加条件を制御して、未露光部分の液晶媒体の透過率を制御することにより、特性曲線を変化させることができる。高速シャッターの場合には、印加電圧を低めにするか、電圧印加時間を短めに設定することにより、特性曲線を高露光側にシフトすることができ、補正することができる。

〔シンクロ撮影方法〕

前述したように、本発明のシステムでは、電圧印加開始前に画像露光することにより、弱い光でも長時間露光することにより、画像記録することができる。このことを利用して、例えば、夜景を背景にして人物をフラッシュ光で撮影するようなことが可能である。図３９に示すように、長時間シャッターで主に背景を画像露光をしている途中で、フラッシュを発光すると同時に電圧印加することにより、夜景と人物を同時に撮影することが可能である。この場合電圧印加とフラッシュ光を同期させることが望ましく、フラッシュの発光後に電圧印加を開始すると、フラッシュ光を有効に利用できない。また、電圧印加を開始する十分前に画像露光をしないと、背景を明るく記録することができない。

なお、図２８に示したように、画像露光時間が長い（約１．５～２秒）と、光誘起電流が飽和してしまい変化しなくなる。このため、それ以上長い時間電圧印加・画像露光しても、有効に画像記録することができない。そこで、光誘起電流が飽和するような長時間露光で画像記録する場合には、図４０に示すように、画像露光開始後、光誘起電流が飽和になる時間で電圧印加を行い（４０～５０ｍｓｅｃ程度）、電圧印加停止後、一定時間経過し、光センサ、液晶媒体各層の電圧が十分減衰した状態で、再び電圧印加することにより、有効に画像記録することができる。なお、図４０では電圧印加を２回行う場合の例について示したが、電圧印加の回数に制限はなく、露光時間に応じて複数回電圧印加してもよい。

次に、本発明の画像露光方法による装置構成の概略について説明する。

図４１は、本発明の画像記録装置の概略構成を示す図である。図中、１０１～１０３は、本発明の画像記録に必要な各種測定手段であり、１０１は測光手段、１０２は光センサのベース電流および／または液晶媒体の抵抗値等の物性値測定手段、１０３はシャッター時間および／または絞り等の撮影条件の入力手段である。なお、ベース電流、液晶媒体の抵抗値等の物性値が予め既知の場合は、入力手段１０３から設定することも可能である。１０４はマイクロコンピュータ等からなる制御装置であり、測光手段１０１で測定された光強度、測定手段１０２の測定結果（あるいは入力された光センサ、液晶媒体の物性値）に基づいてシャッター時間を算出・設定し、また、電圧印加条件（印加電圧、電圧印加時間）を設

定する。制御装置１０４は、設定したシャッター時間と電圧印加条件に適したタイミング（方法）で電源３０およびシャッター７０を制御し、光センサ１０、液晶媒体２０への電圧印加・露光を制御して最適条件で撮影する。なお、７１はレンズである。

次に、電圧印加開始前に露光する方法を用いたカメラ及びその動作シーケンスについて説明する。

図４２は本発明の電圧印加・画像露光方法を適用したカメラの一実施例を説明する図である。

本実施例では一眼レフカメラ６０に回転式のシャッタ６７を組み込み、従来のフィルムの代わりに液晶記録媒体を使用するようにした例である。ミラー６２は、図示しない電源スイッチをＯＮ／ＯＦＦするのに連動して図の実線の位置と破線の位置に回動し、図の実線の位置において撮影レンズ６１からの光をミラー６２、ペンタプリズム６４で方向を変え、接眼レンズ６５を通して被写体を観察し、ピント合わせ等を行えるようになっている。撮影時に電源スイッチをＯＮすると、ミラー６２が破線の位置に跳ね上げられ、被写体からの光は撮影レンズ６１、フィルタ６８、回転式シャッタ６７を通して媒体ホルダ６９に照射される。回転式シャッタ６７及び媒体ホルダ６９は制御装置６６で連動して動作する。

媒体ホルダ６９は、図４３に示すように、光センサ１０と液晶記録媒体２０をスペーサ１６により約９μｍの空隙を介して対向させて保持しており、光センサ１０と液晶記録媒体２０の両電極間に光センサが正になるように電圧印加して光センサの支持体側から画像露光するように構成されている。なお、液晶記録媒体としては、光センサ上に直接或いは中間層を介して液晶層、電極層が形成された一体型のものであってもよい。

図４４は、撮像シーケンスの１例を示し、ミラー（撮影光学系）または記録媒体を移動させ、シャッタを３回開閉して電圧印加前に画像１、画像２を露光し、電圧印加後に画像３を露光している。このようなシーケンスで、媒体の異なる位置に画像１～３を記録することができる。

図４５は画像１～３の露光中、シャッターを開けている以外は図４４の場合と同じであり、同様に媒体の異なる位置に画像１～３を記録することができる。

図４６はストロボ発光による撮像シーケンスを示し、図４５と同様なシーケンスで３回のストロボ発光を行って画像記録がなされる。

本発明の光センサは、情報光の露光の後に、光センサの電極と情報記録媒体との電極間に電圧を印加するか、情報光を露光した状態で光センサの電極と情報記録媒体との電極間に印加する電圧を断続化、あるいは電圧の印加を停止した後に再度電圧の印加を行うようにしたので、未露光部と露光部の導電性の差が大きいので、液晶によって記録する場合にも未露光部の電圧が液晶のしきい値電圧以上には上昇しないので、弱い光による長時間露光によってもコントラストの大きな情報を記録することができる。

また、本発明は、電圧印加開始前に画像露光することにより、記録画像のラチチュードを変えたり、また、記録感度を補正することができるので、カメラに必要な相反則を成り立たせるような補正を行うことも可能となる。

WHAT WE CLAIM IS：

（１）電極上に光導電層を有し、情報記録媒体への情報形成に使用される光センサにおいて、光センサに電圧を印加しない状態、または逆極性の電圧を印加した状態で、露光した後に電圧印加したときに、露光量に応じて光誘起電流が発生し、情報記録が可能であることを特徴とする光センサ。

（２）　電極上に光導電層を有し、情報記録媒体への情報形成に使用される光センサにおいて、電圧を印加した状態で情報露光することによって露光部の導電性が未露光部の導電性よりも増加し、情報露光終了後も露光した部分の導電性が、未露光部分の導電性よりも高く、さらに情報露光した状態、または情報露光終了後に、電圧印加を停止、または逆極性の電圧を印加した後、再びもとの電圧を印加することにより、電圧を印加し続けた場合と導電性が等しくなることを特徴とする光センサ。

（３）光センサへの$１０^{５}$～$１０^{６}$Ｖ／$ｃｍ^{２}$の電界の印加時に、未露光部での通過電流密度が$１０^{－４}$～$１０^{－７}$Ａ／$ｃｍ^{２}$である請求項１または２記載の光センサ。

（４）情報露光によって情報記録媒体へ光情報を記録する情報記録方法において、請求項１または３記載の光センサと電極上に情報記録層を形成した情報記録媒体を使用し、光センサもしくは情報記録媒体の少なくともいずれか一方の電極を透明電極とするとともに、光センサと情報記録媒体を間隙を設けて光軸上に対向配置するか、または、光センサと情報記録媒体を直接または誘電体中間層を介して積層し、光情報の露光を行った後に、または光情報の露光中に両電極間に電圧印加を開始することを特徴とする情報記録方法。

（５）請求項４記載の方法において、前記情報記録媒体が、電極上に、液晶と樹脂からなる高分子－液晶複合体層を形成した液晶記録媒体であることを特徴とする情報記録方法。

（６）請求項５記載の方法において、光情報の露光終了から一定時間経過後に電圧印加を開始することにより、記録する画像のラチチュードを広げることを特徴とする情報記録方法。

（７）請求項６記載の方法において、光情報の露光終了から電圧印加開始までの

時間が０〜５００ｍｓｅｃであることを特徴とする情報記録方法。

（８）情報露光によって情報記録媒体へ光情報を記録する情報記録再生方法において、請求項2または3に記載の光センサと電極上に情報記録層を形成した情報記録媒体を使用し、光センサもしくは情報記録媒体の少なくともいずれか一方の電極を透明電極とするとともに、光センサと情報記録媒体を間隙を設けて光軸上に対向配置するか、または、光センサと情報記録媒体を直接または誘電体中間層を介して積層し、光情報の露光を行うとともに、光情報の露光を行っている間、または光情報の露光終了後に、電圧を印加しない期間もしくは逆極性の電圧を印加する期間を設けることを特徴とする情報記録方法。

（９）請求項8記載の情報記録方法において、前記情報記録媒体が、電極上に、液晶と樹脂からなる高分子ー液晶複合体層を形成した液晶記録媒体であることを特徴とする情報記録方法。

（１０）情報露光によって情報記録媒体へ光情報を記録する情報記録方法において、光センサと、電極上に情報記録層を形成した情報記録媒体を使用し、光センサもしくは情報記録媒体の少なくともいずれか一方の電極を透明電極とするとともに、光センサと情報記録媒体を間隙を設けて光軸上に対向配置するか、または、光センサと情報記録媒体を直接または誘電体中間層を介して積層し、光センサに情報露光し、光センサと情報記録媒体の両電極間に電圧印加して情報記録する方法において、シャッター速度に応じて、適切な画像露光と電圧印加方法を測定し、広い範囲で相反則が成り立つようにしたことを特徴とする情報記録方法。

（１１）請求項１０記載の情報記録方法において、前記情報記録媒体が、電極上に、液晶と樹脂からなる高分子ー液晶複合体層を形成した液晶記録媒体であることを特徴とする情報記録方法。

（１２）請求項１１記載の情報記録方法において、予め測定しておいたシャッター速度と記録特性の関係を基に、絞り又は露光時間を補正することで広い範囲で相反則が成り立つようにしたことを特徴とする情報記録方法。

（１３）請求項１１記載の情報記録方法において、請求項1または3記載の光センサを使用し、電圧印加開始前に画像露光を開始することにより、相反則不軌を補正することを特徴とする情報記録方法。

（１４）請求項１１記載の情報記録方法において、請求項2または3記載の光センサを使用し、画像露光中または画像露光終了後に、電圧印加しない期間もしくは逆極性の電圧を印加する期間を設けることにより、相反則不軌を補正することを特徴とする情報記録方法。

（１５）請求項１１記載の情報記録方法において、請求項1または3記載の光センサを使用し、画像露光終了後、一定時間経過後に電圧印加を開始することにより、相反則不軌を補正することを特徴とする情報記録方法。

（１６）請求項１１記載の情報記録方法において、印加電圧および／または電圧印加時間を制御することにより相反則不軌を補正することを特徴とする画像情報記録方法。

（１７）情報露光によって情報記録媒体へ光情報を記録する情報記録装置において、光センサと電極上に情報記録層を形成した情報記録媒体を使用し、光センサもしくは情報記録媒体の少なくともいずれか一方の電極を透明電極とするとともに、光センサと情報記録媒体を間隙を設けて光軸上に対向配置するか、または、光センサと情報記録媒体を直接または誘電体中間層を介して積層し、光情報の露光を行った後に、または光情報の露光中に両電極間に電圧印加を開始する機構を設けたことを特徴とする情報記録装置。

（１８）透明電極上に光導電層を積層した光センサと、電極上に情報記録層を積層した情報記録媒体を空隙を介して光軸上に対向配置するか、または、光センサの光導電層上に直接または誘電体中間層を介して情報記録層を積層し、さらに上部電極を形成した一体型媒体において光センサに画像露光し、両電極間に電圧印加することにより、露光量に応じて画像情報等を記録する装置において、露光強度を測光し、露光時間を算出する手段を有し、および／または露光時間を入力する手段を有し、露光時間の広い範囲で相反則が成り立つように、露光時間に応じて適切な条件でシャッターと電源を制御する機能を有することを特徴とする情報記録装置。

ABSTRACT

電極上に光導電層を積層してなる光センサと、電極上に電界または電荷により情報記録可能な情報記録層を積層してなる情報記録媒体とが対向させて配置され、情報光によって露光した後に光センサの電極と情報記録媒体との電極間に電圧を印加するか、情報光を露光した状態で光センサの電極と情報記録媒体との電極間の電圧印加を停止、もしくは逆極性の電圧の印加後に再度電圧の印加を行うようにしたので、未露光部と露光部の導電性の差が大きいので、弱い光による長時間露光によってもコントラストの大きな情報を記録することができる。

また、本発明は電圧印加開始より前に画像露光し、その時間差を変えることにより記録画像のラチチュードを変えることができ、また、本発明の記録方法をカメラに適用した場合、カメラに必要な相反則を成り立たせるように補正することが可能である。

図1

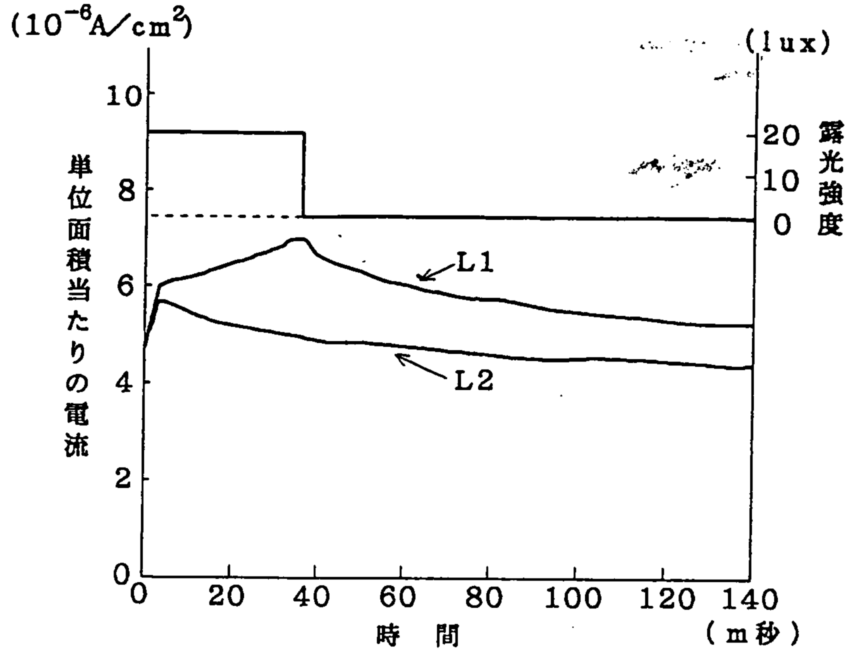

(10⁻⁶A/cm²)
(lux)
単位面積当たりの電流
露光強度
10
8
6
4
2
0
20
10
0
L1
L2
0
20
40
60
80
100
120
140
時　間
(m秒)

図2

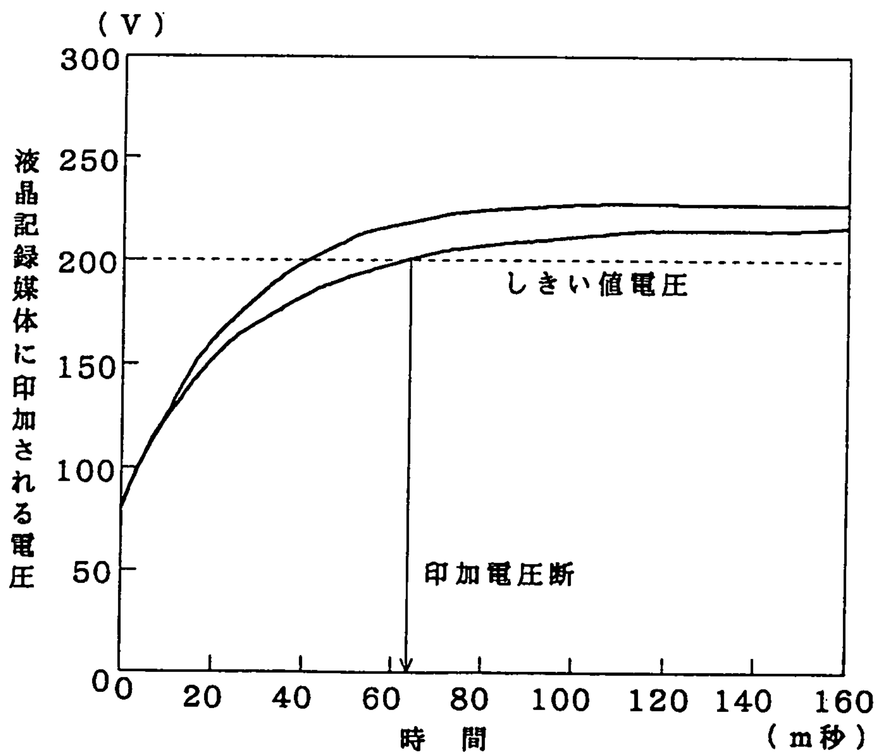

(V)
液晶記録媒体に印加される電圧
300
250
200
150
100
50
0
しきい値電圧
印加電圧断
0
20
40
60
80
100
120
140
160
時　間
(m秒)

図3

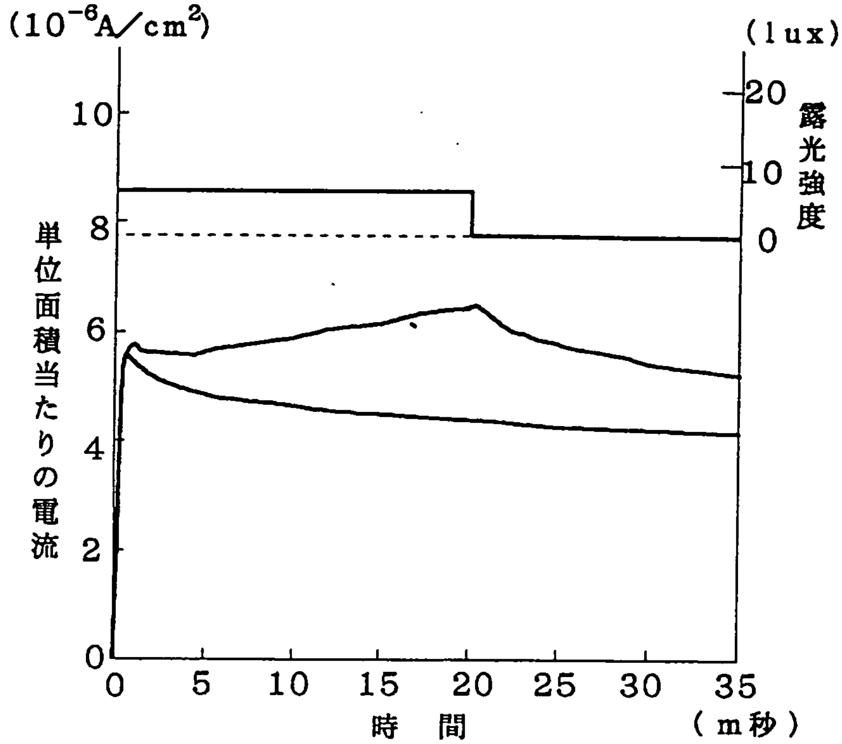

(10⁻⁶A/cm²)
(lux)
単位面積当たりの電流
露光強度
0
2
4
6
8
10
0
10
20
0
5
10
15
20
25
30
35
時　間
(m秒)

図4

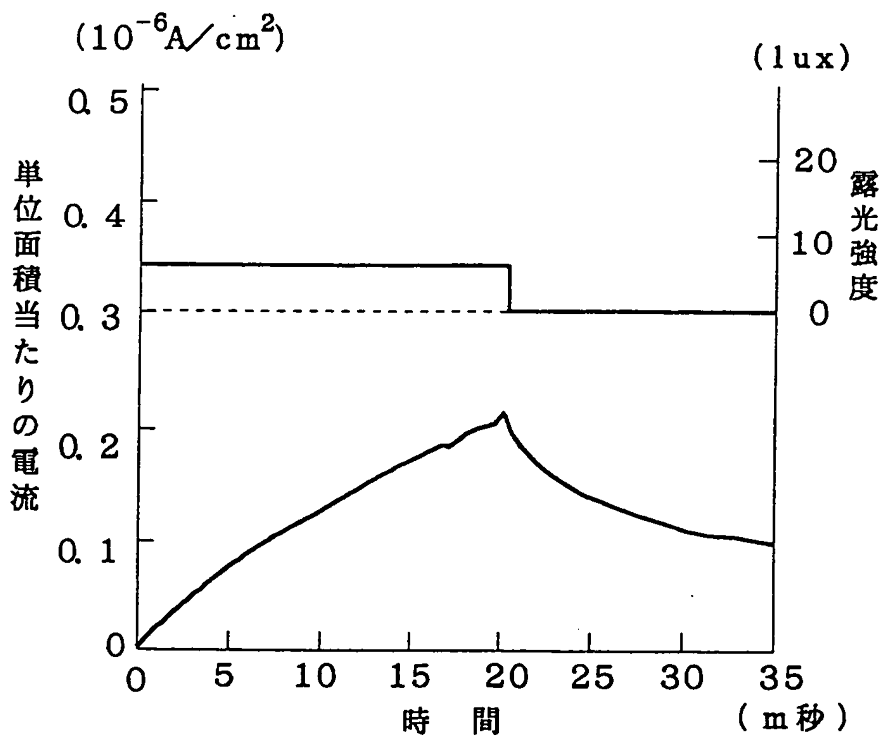
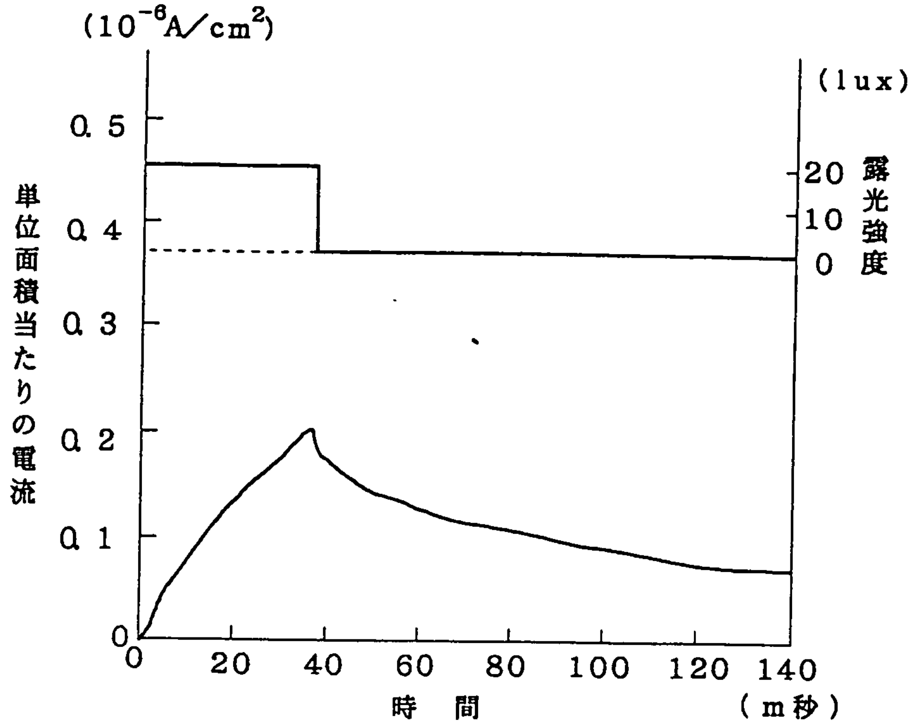
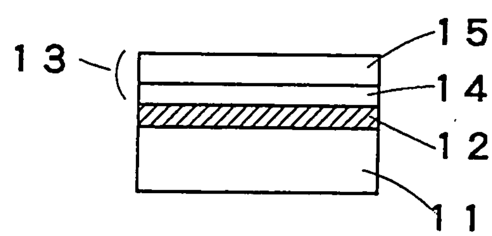

(10⁻⁶A/cm²)
(lux)
単位面積当たりの電流
露光強度
0
0.1
0.2
0.3
0.4
0.5
0
10
20
0
5
10
15
20
25
30
35
時　間
(m秒)

図5



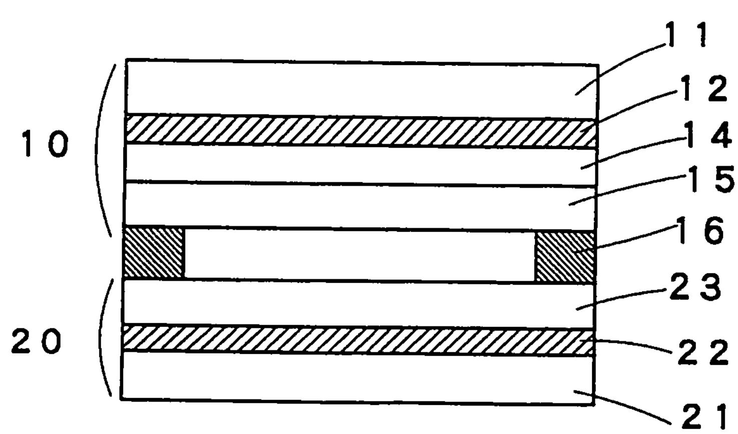
$(10^{-6}A/cm^2)$
(lux)
0.5
0.4
0.3
0.2
0.1
0
単位面積当たりの電流
20
10
0
露光強度
0
20
40
60
80
100
120
140
時間
(m秒)

図6



13
15
14
12
11

図7



10
20
11
12
14
15
16
23
22
21

図8

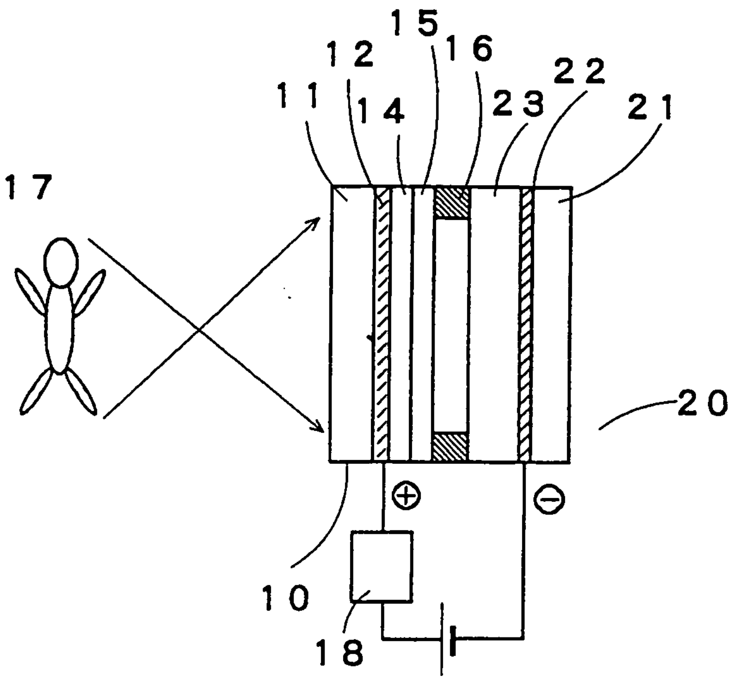


図9

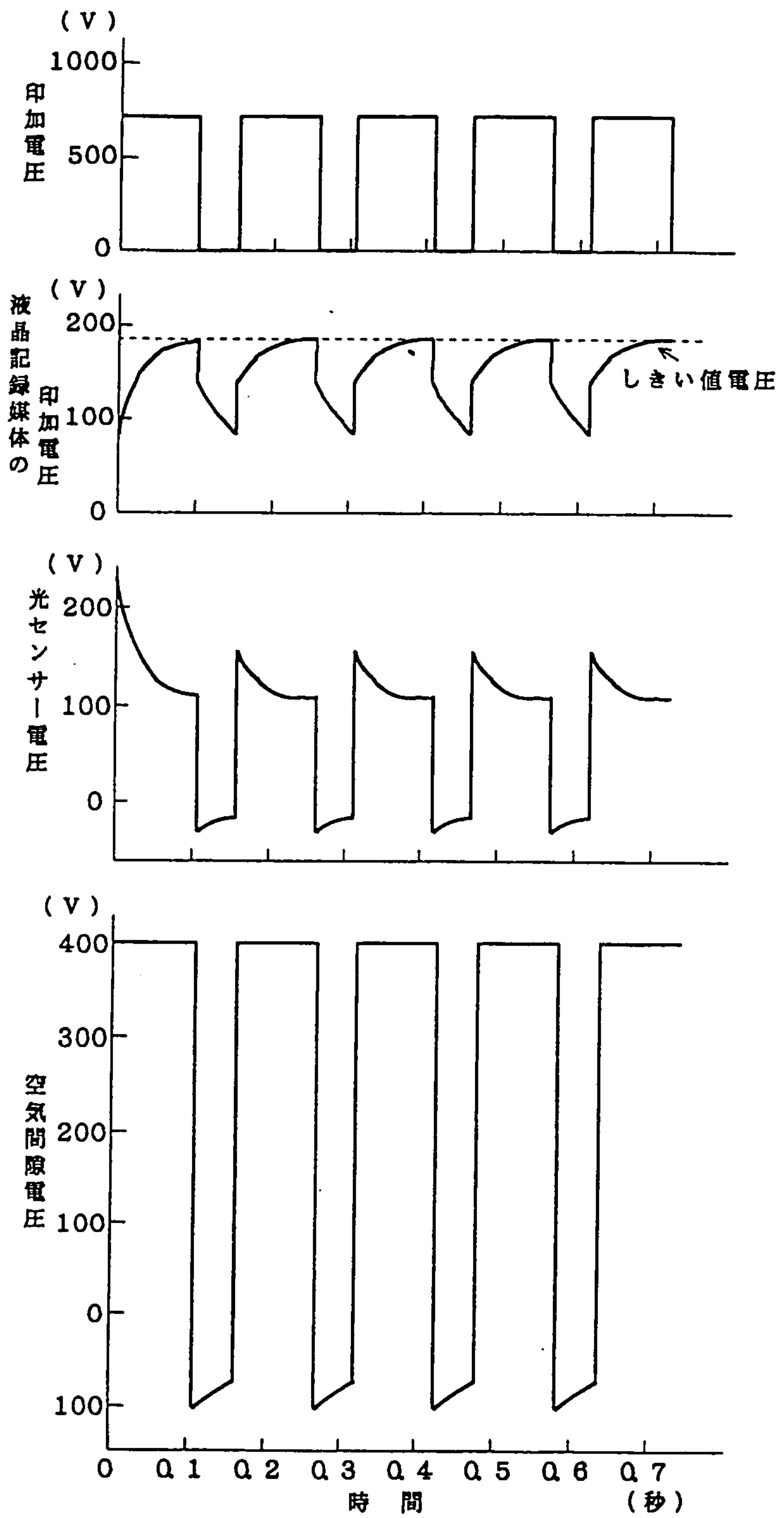

(V)
1000
500
0
印加電圧
(V)
200
100
0
液晶記録媒体の印加電圧
しきい値電圧
(V)
200
100
0
光センサー電圧
(V)
400
300
200
100
0
100
空気間隙電圧
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
時間
(秒)

図１０

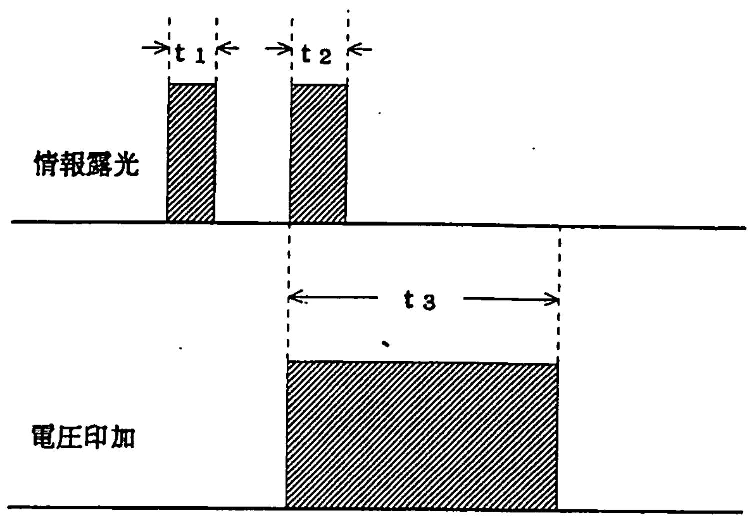


図１１

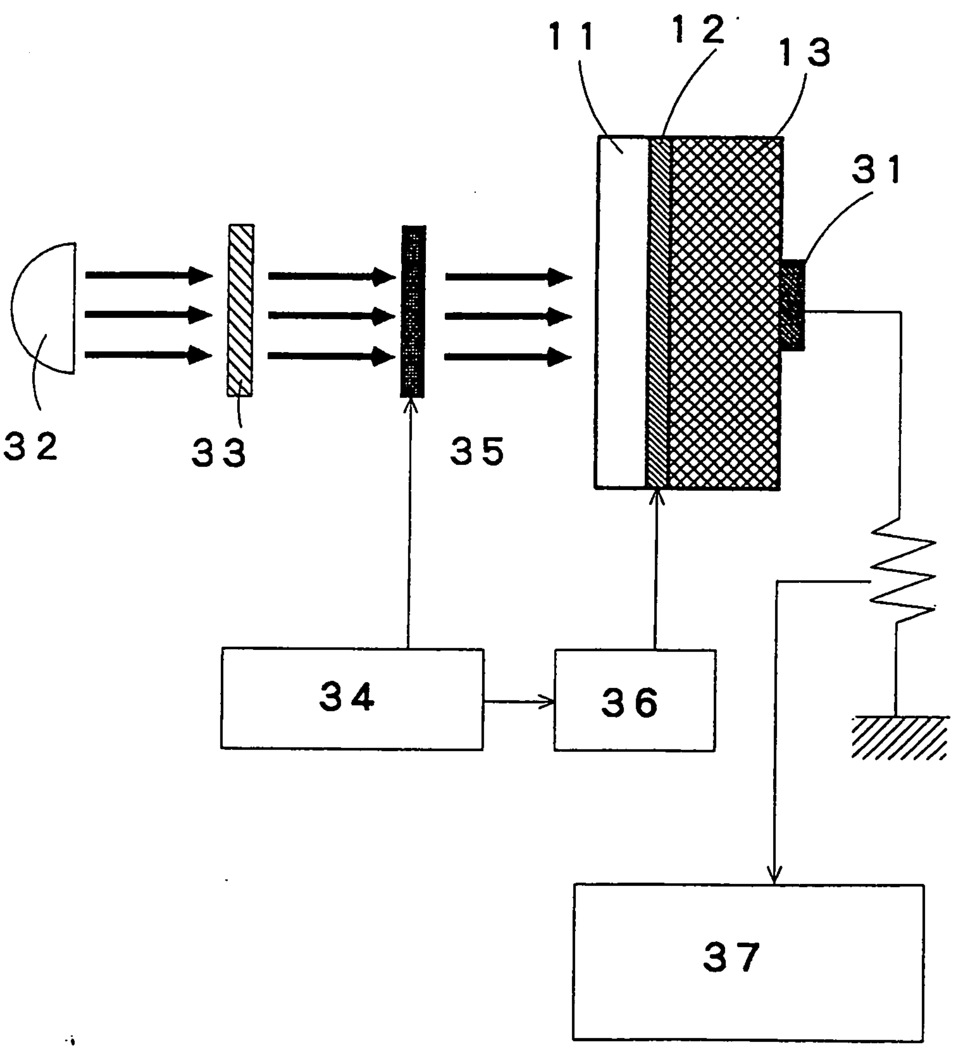
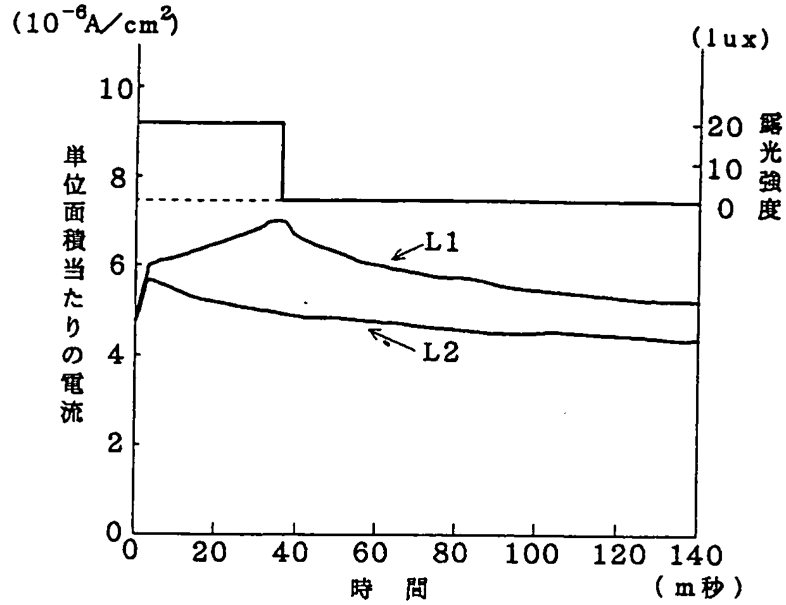
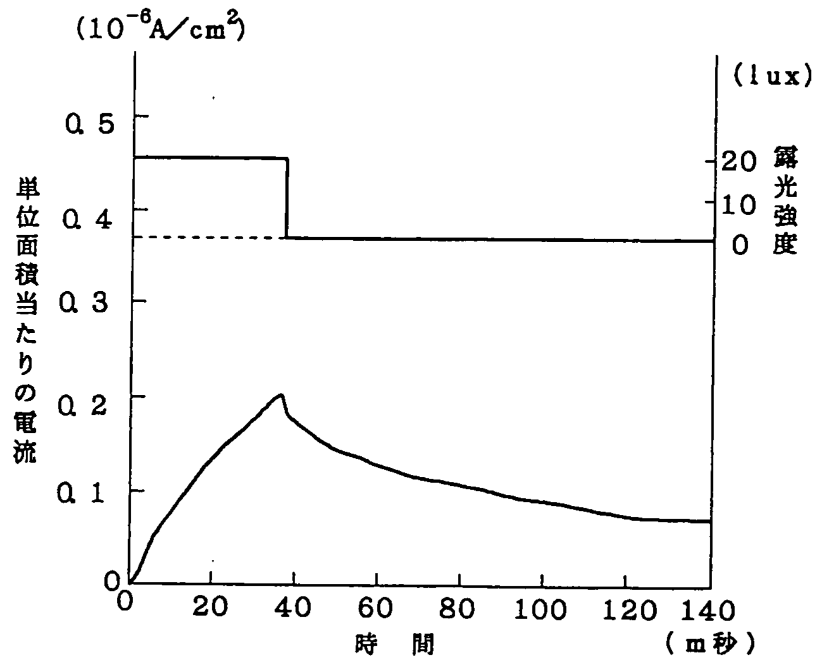


図１２



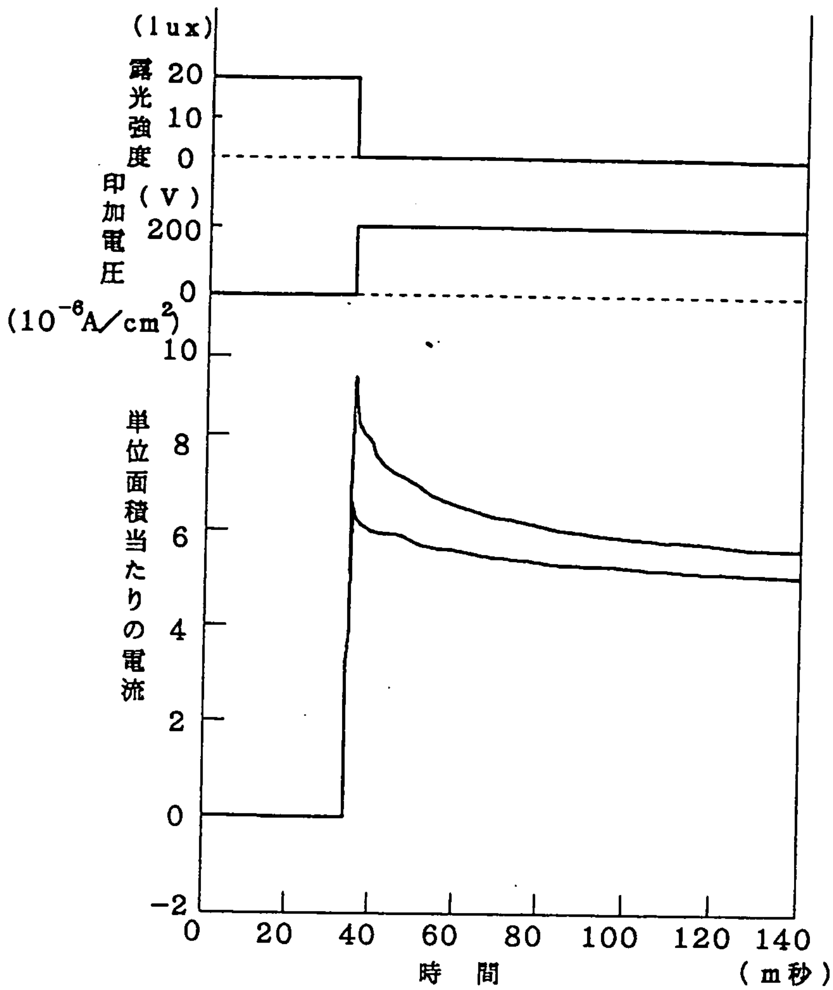
(10⁻⁶A/cm²)
(lux)
10
8
6
4
2
0
20
10
0
露光強度
単位面積当たりの電流
L1
L2
0
20
40
60
80
100
120
140
時間
(m秒)

図１３



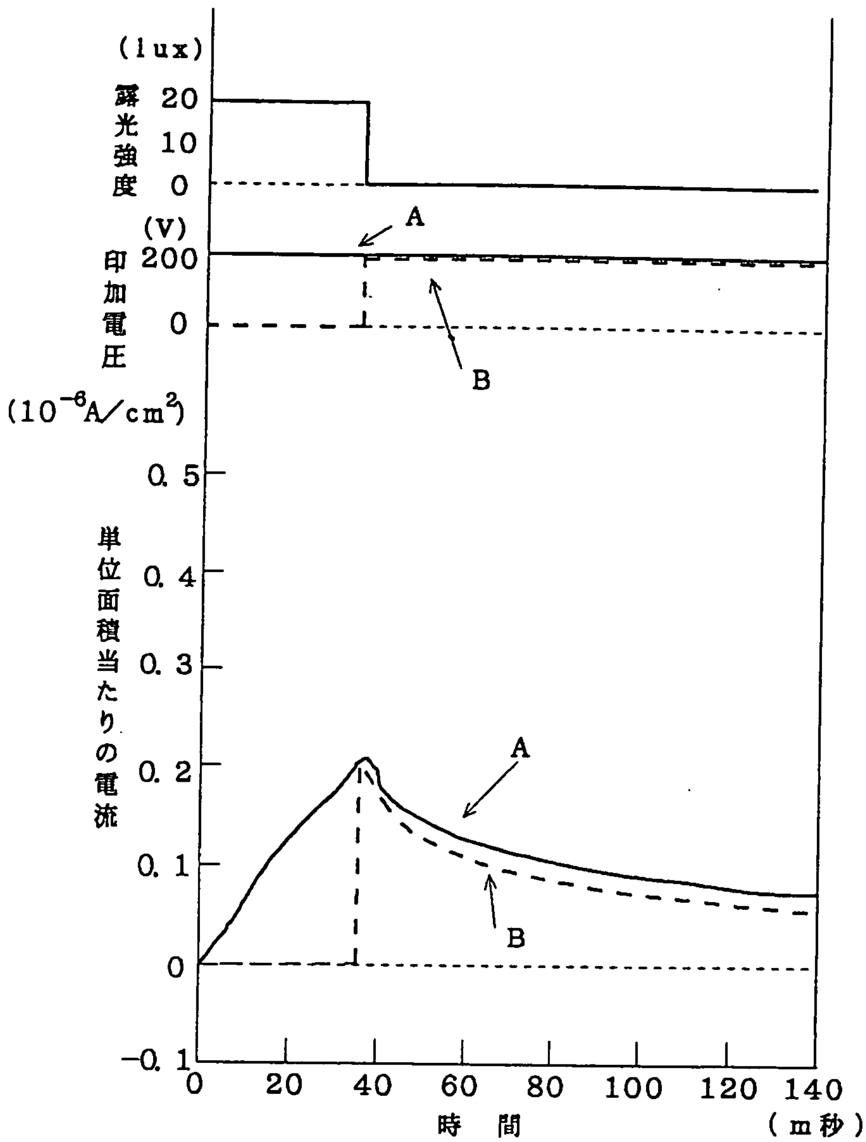
(10⁻⁶A/cm²)
(lux)
0.5
0.4
0.3
0.2
0.1
0
20
10
0
露光強度
単位面積当たりの電流
0
20
40
60
80
100
120
140
時間
(m秒)

図１４



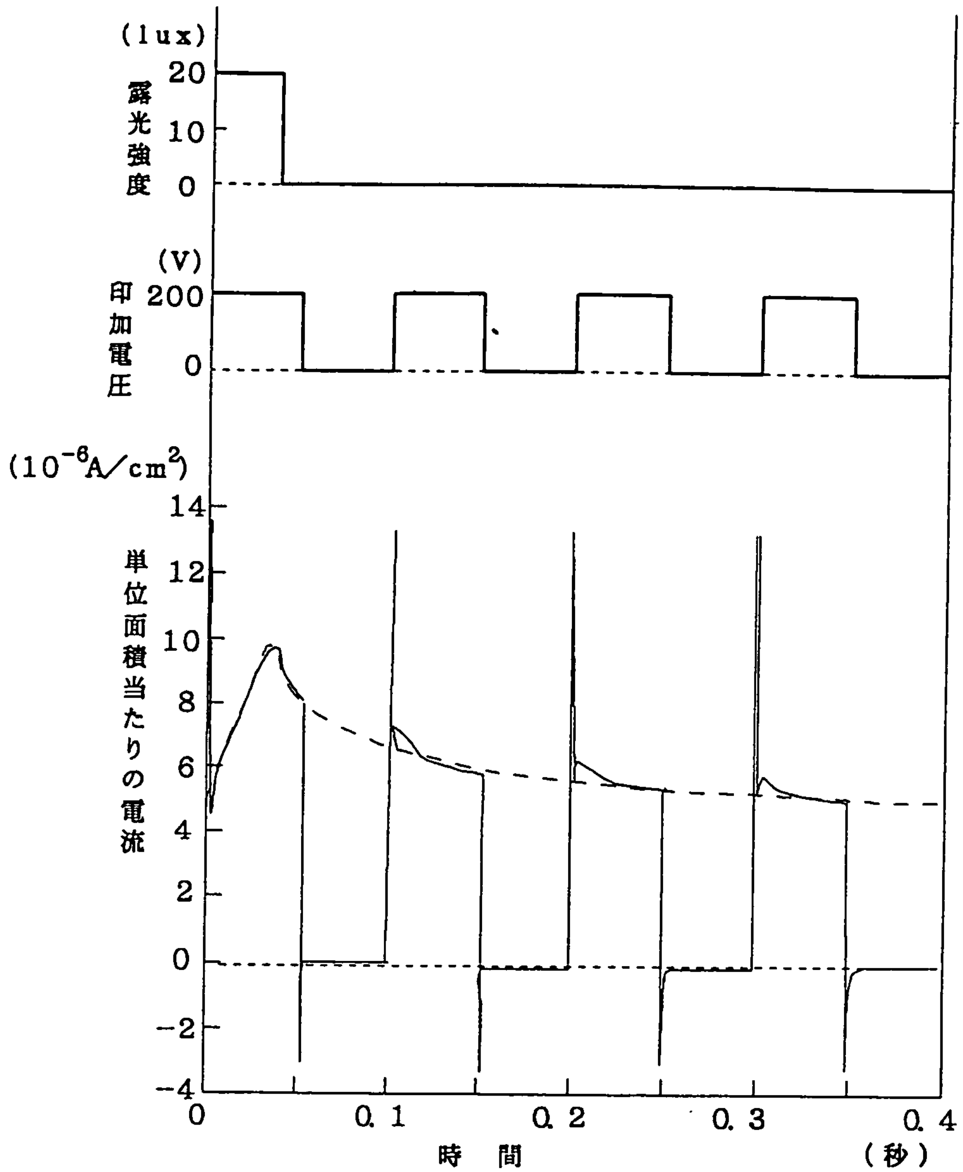
(lux)
露光強度
20
10
0
印加電圧
(V)
200
0
$(10^{-6}A/cm^2)$
単位面積当たりの電流
10
8
6
4
2
0
−2
0
20
40
60
80
100
120
140
時間
(m秒)

図１５



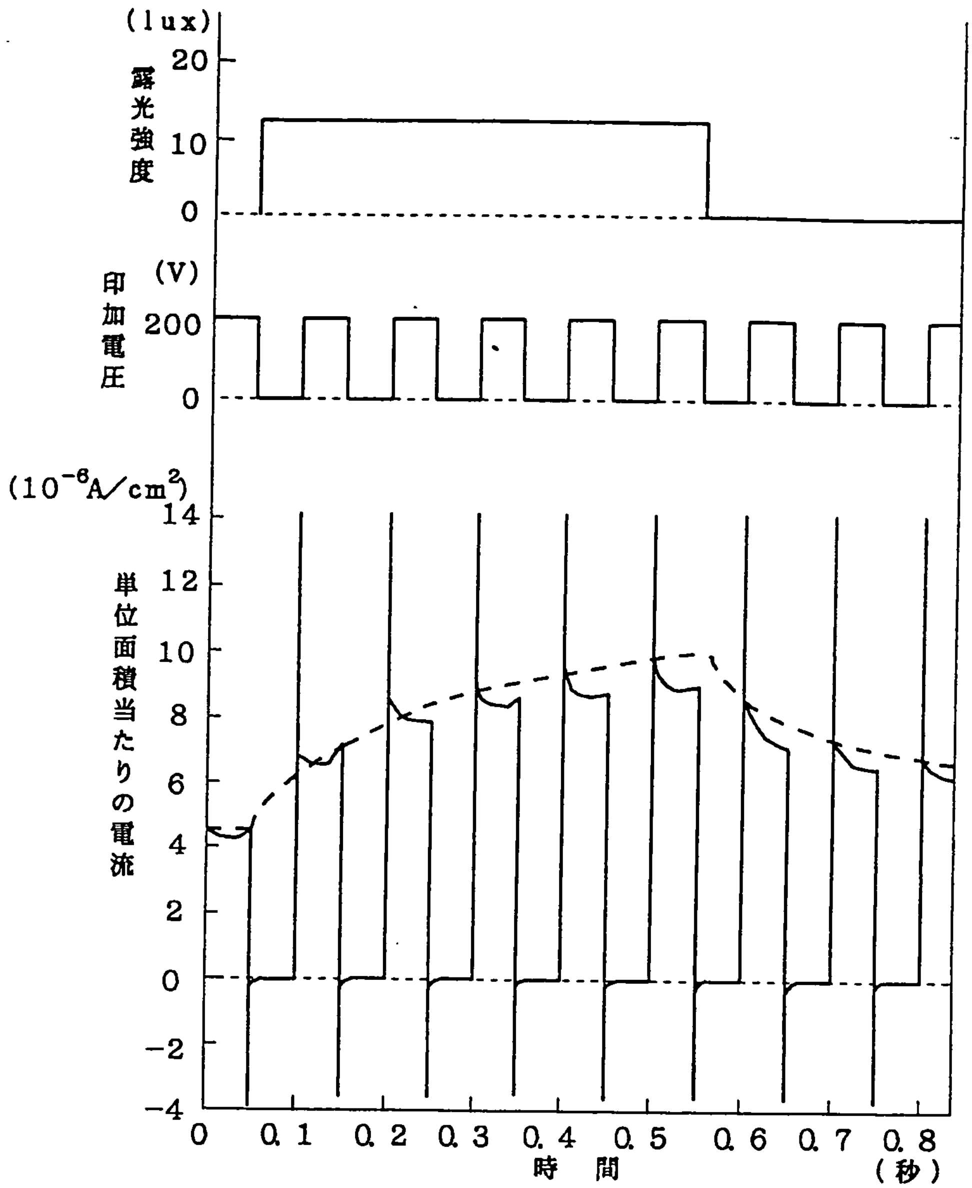
(lux)
露光強度
20
10
0
(V)
A
印加電圧
200
0
B
$(10^{-6}A/cm^2)$
単位面積当たりの電流
0.5
0.4
0.3
0.2
0.1
0
−0.1
A
B
0
20
40
60
80
100
120
140
時間
(m秒)

図16



(lux)
露光強度
20
10
0
(V)
印加電圧
200
0
(10^{-6}A/cm^2)
単位面積当たりの電流
14
12
10
8
6
4
2
0
−2
−4
0
0.1
0.2
0.3
0.4
時間
(秒)

図１７



(lux)
20
露光強度
10
0
印加電圧
(V)
200
0
$(10^{-6}A/cm^2)$
14
12
単位面積当たりの電流
10
8
6
4
2
0
−2
−4
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
時間
(秒)

図18

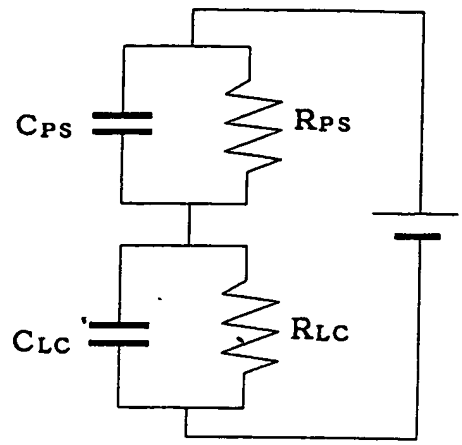

CPS
RPS
CLC
RLC

図19

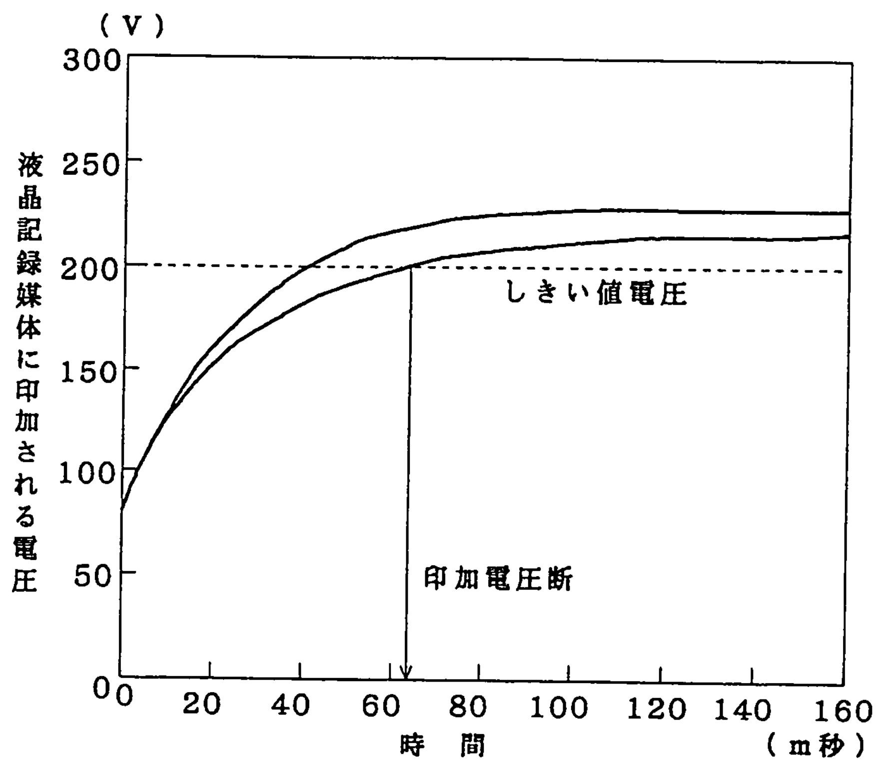
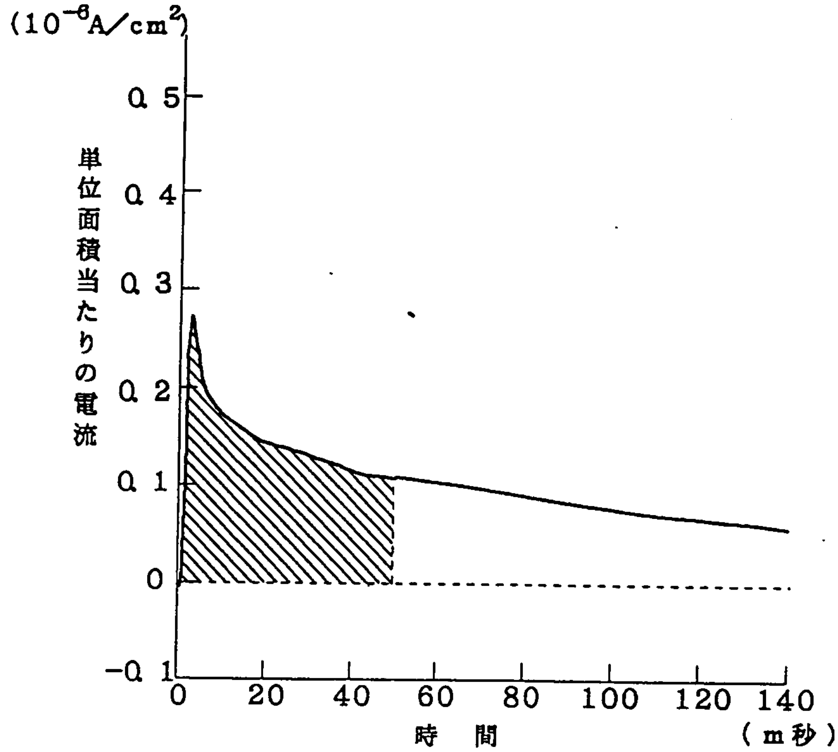
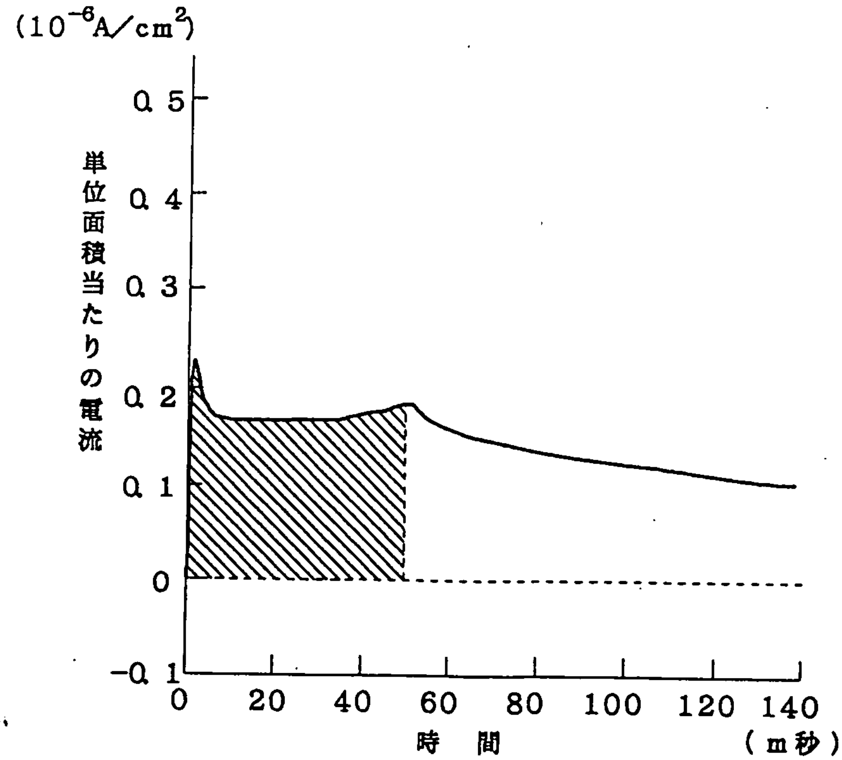

(V)
300
250
200
150
100
50
0
液晶記録媒体に印加される電圧
しきい値電圧
印加電圧断
0
20
40
60
80
100
120
140
160
時 間
(m秒)

図２０



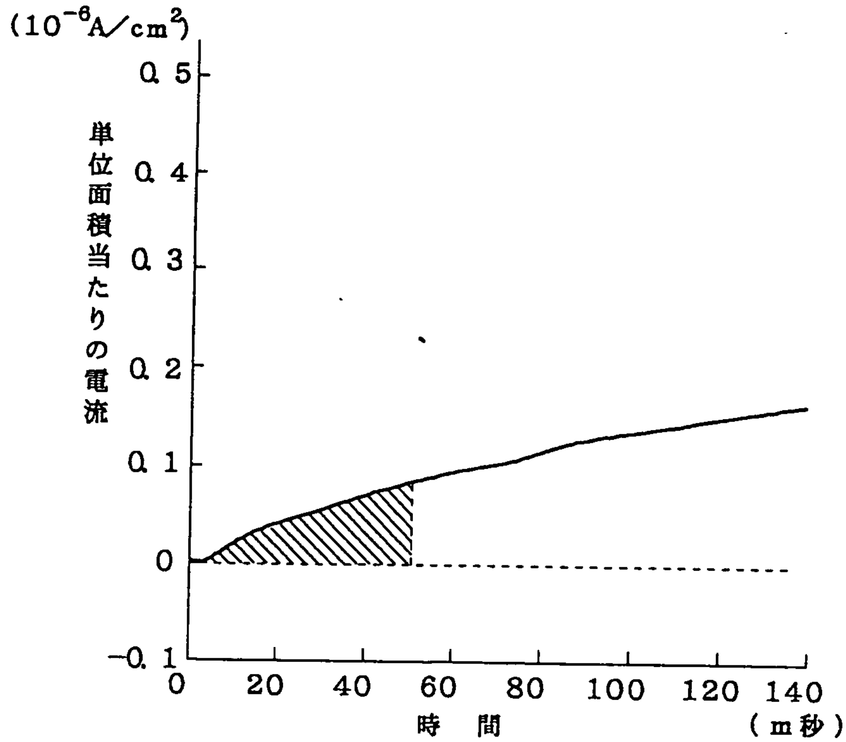
(10⁻⁶A/cm²)
0.5
0.4
0.3
0.2
0.1
0
−0.1
単位面積当たりの電流
0
20
40
60
80
100
120
140
時　間
（ｍ秒）

図２１



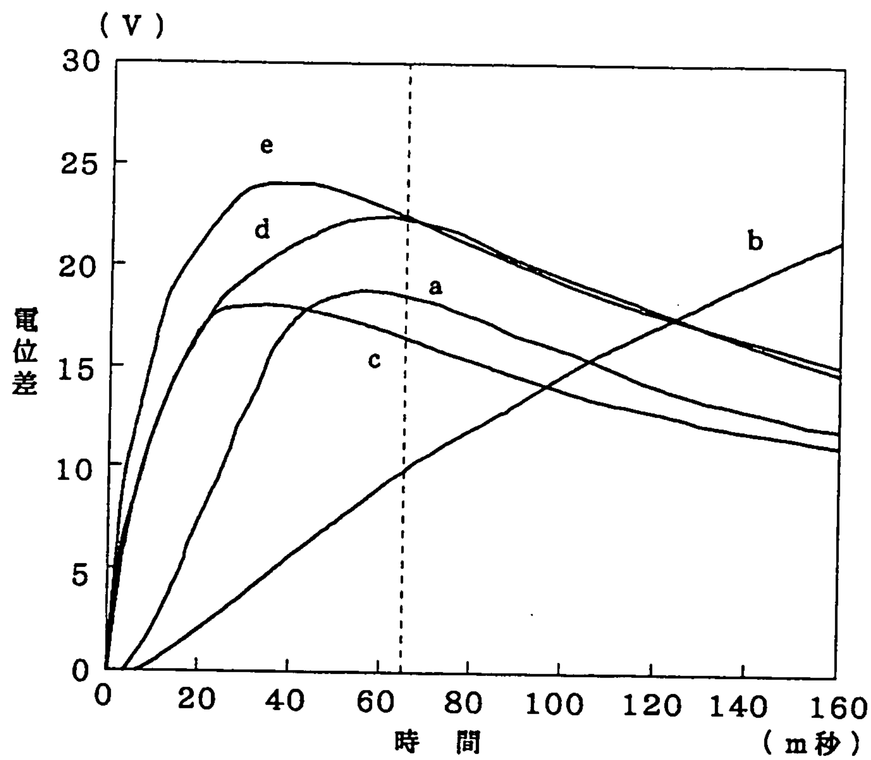
(10⁻⁶A/cm²)
0.5
0.4
0.3
0.2
0.1
0
−0.1
単位面積当たりの電流
0
20
40
60
80
100
120
140
時　間
（ｍ秒）

図２２



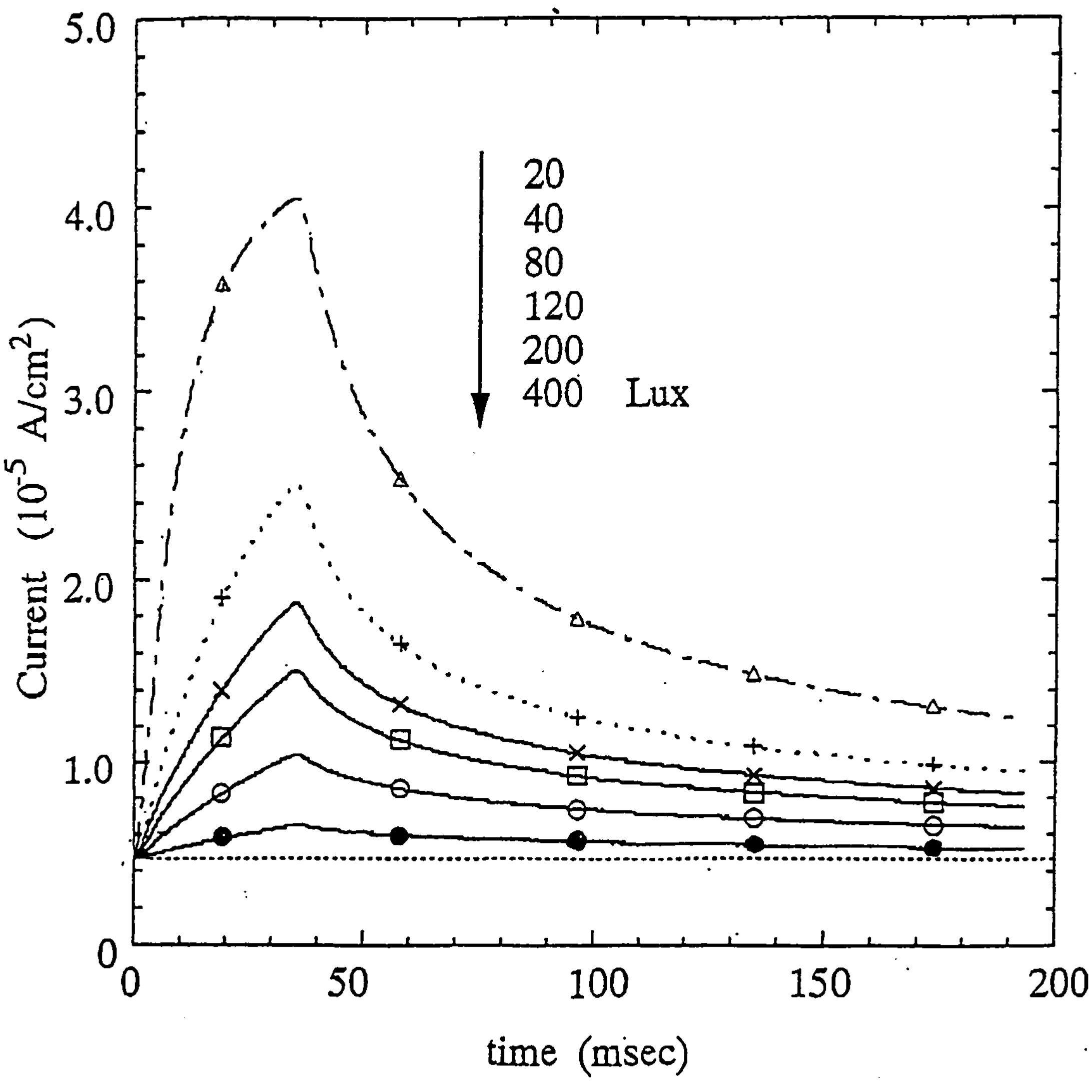
(10^{-6}A／cm^2)
0.5
0.4
0.3
0.2
0.1
0
−0.1
単位面積当たりの電流
0
20
40
60
80
100
120
140
時　間
(ｍ秒)

図２３



(Ｖ)
30
25
20
15
10
5
0
電位差
e
d
a
c
b
0
20
40
60
80
100
120
140
160
時　間
(ｍ秒)

図24



5.0
4.0
3.0
2.0
1.0
0
0
50
100
150
200
Current (10^{-5} A/cm^2)
time (msec)
20
40
80
120
200
400 Lux

図25

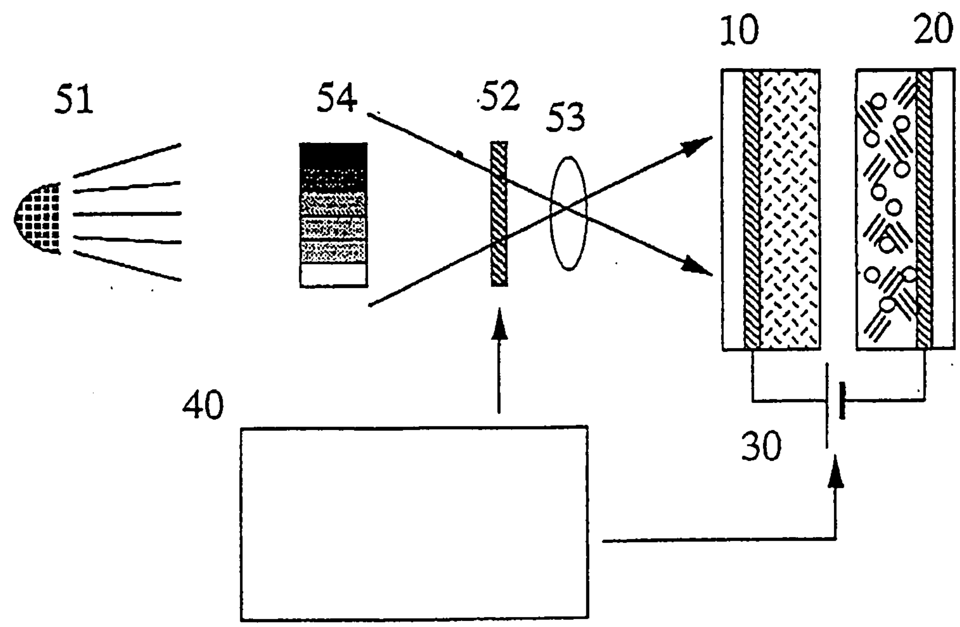


図26

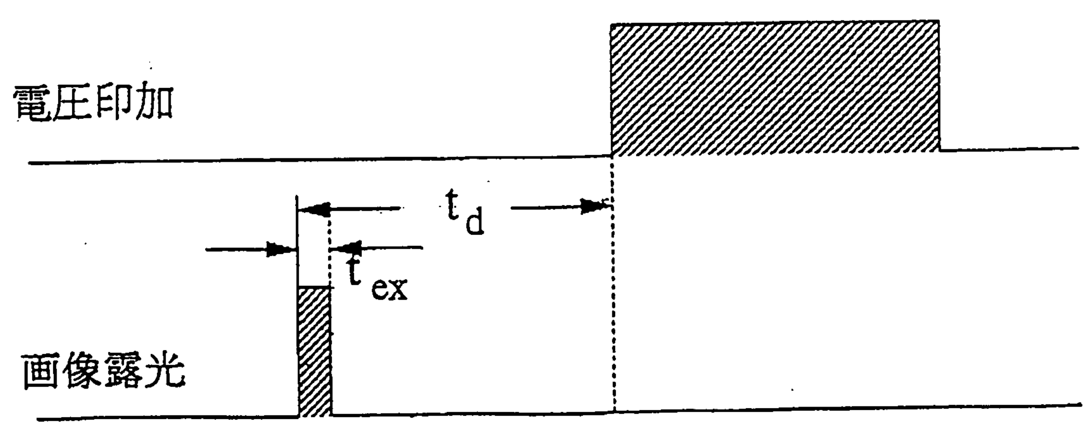
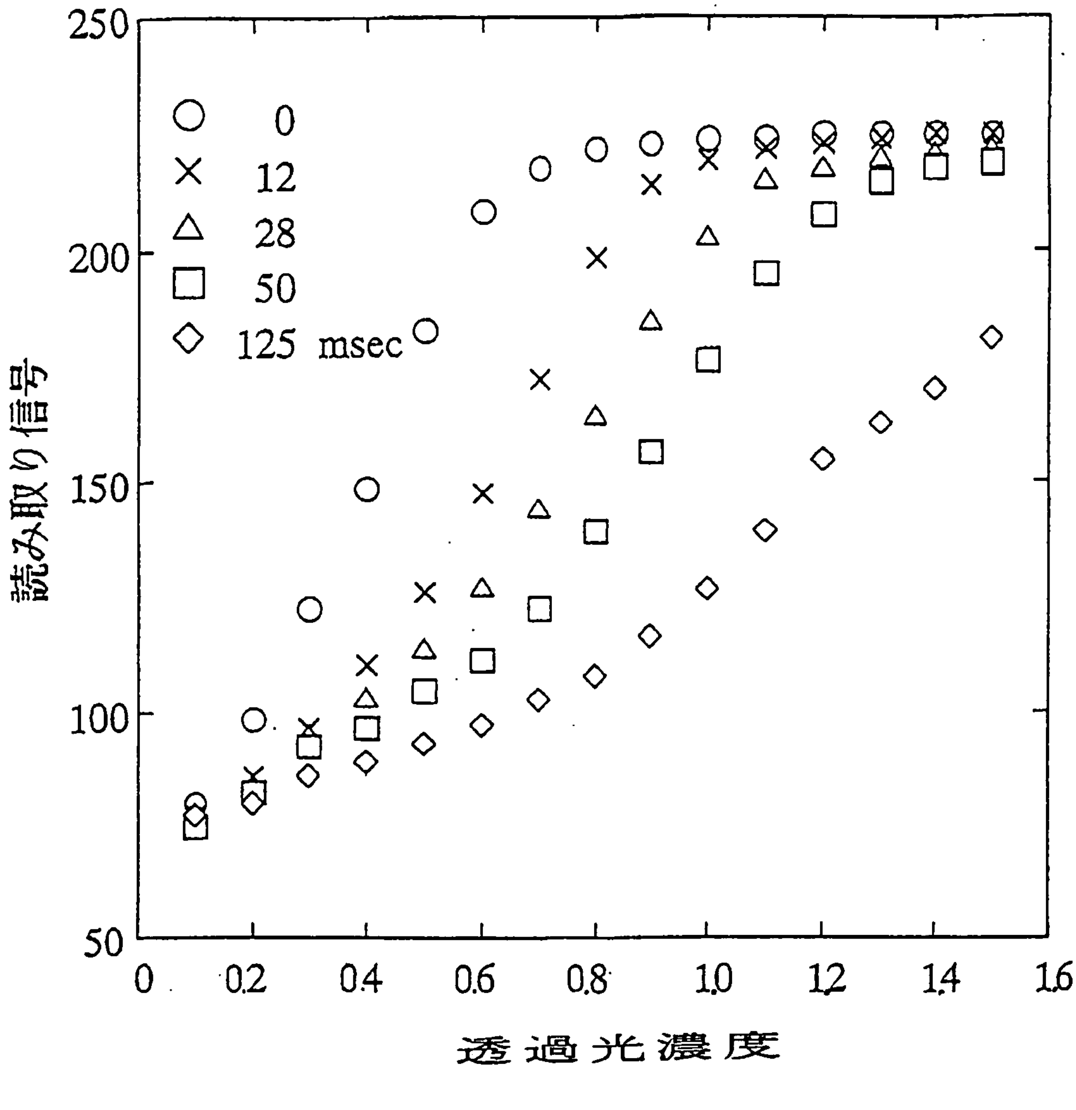


図27



0
12
28
50
125 msec
250
200
150
100
50
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
読み取り信号
透過光濃度

図28

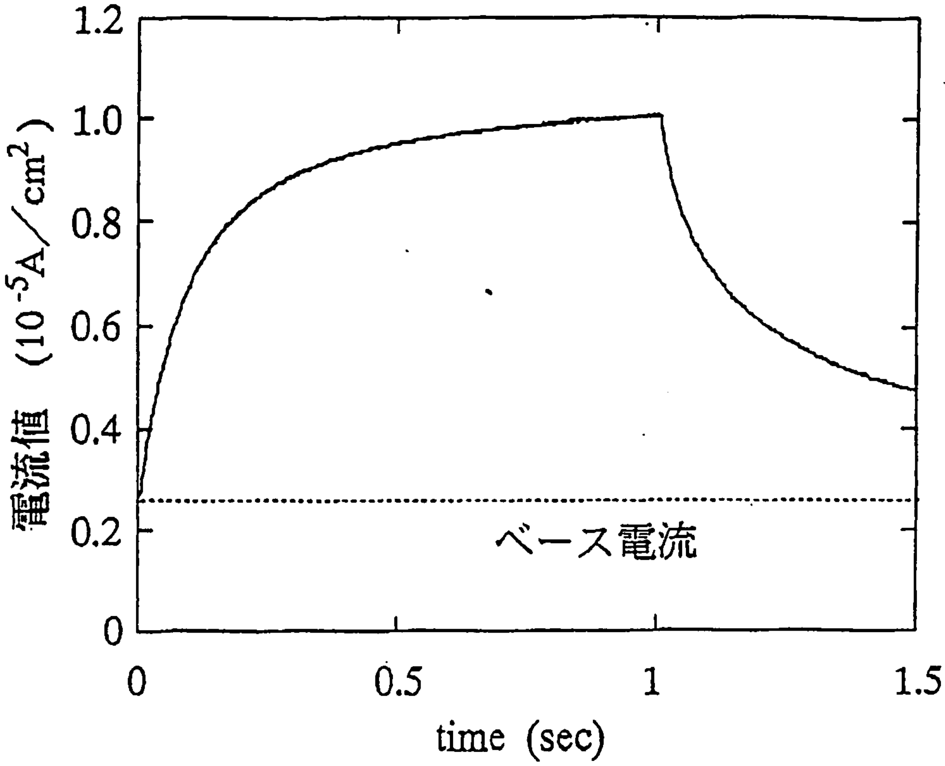


図29

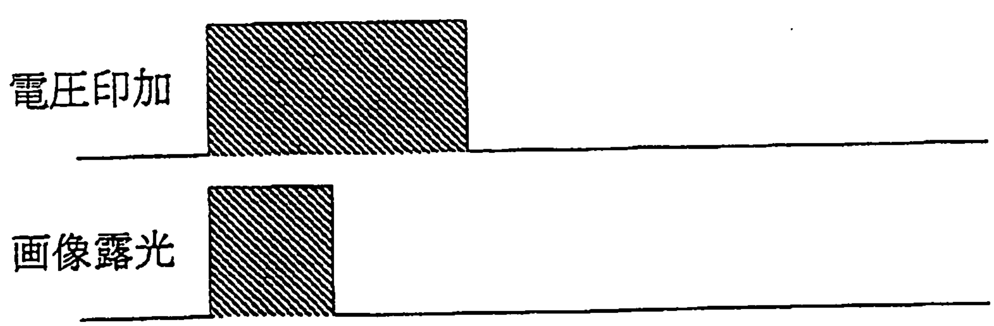
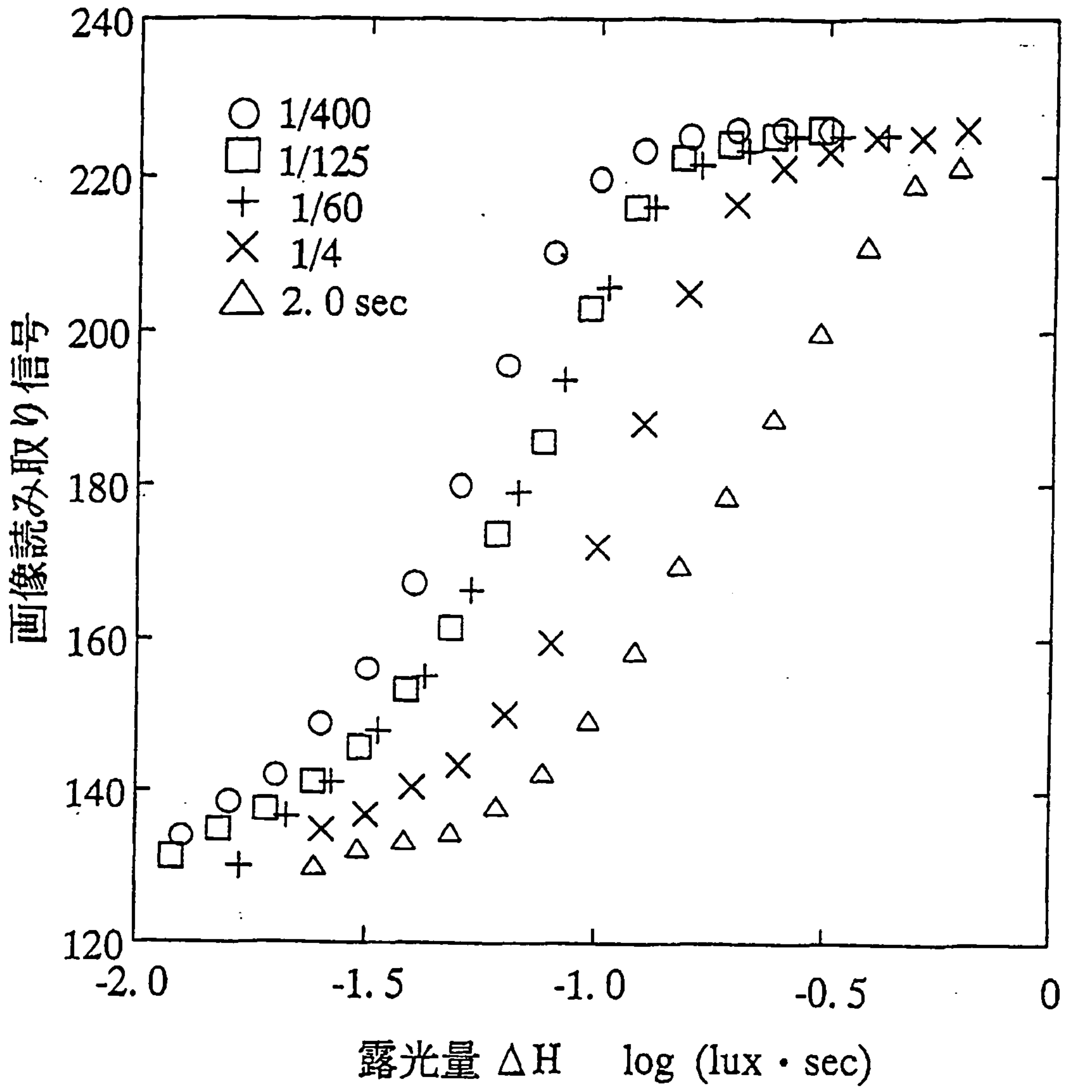


図30



240
220
200
180
160
140
120
1/400
1/125
1/60
1/4
2. 0 sec
画像読み取り信号
-2. 0
-1. 5
-1. 0
-0. 5
0
露光量 ΔH log (lux・sec)

図31

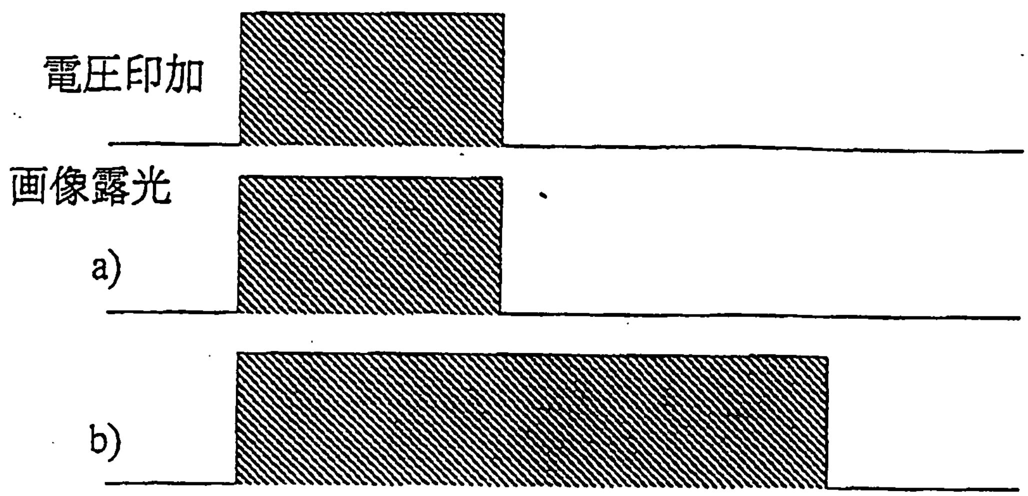


図32

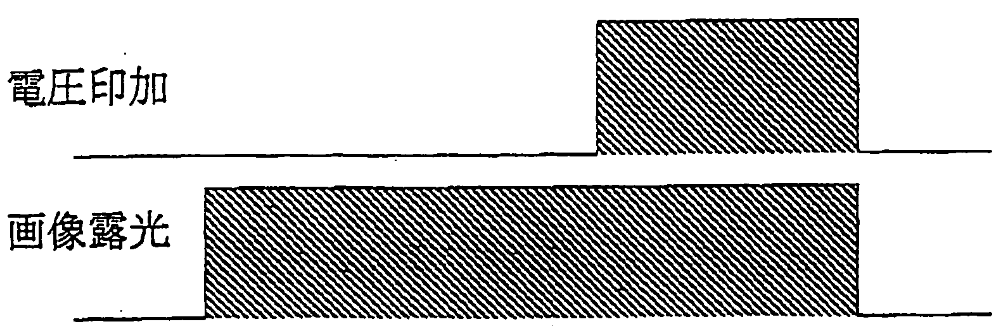


図33

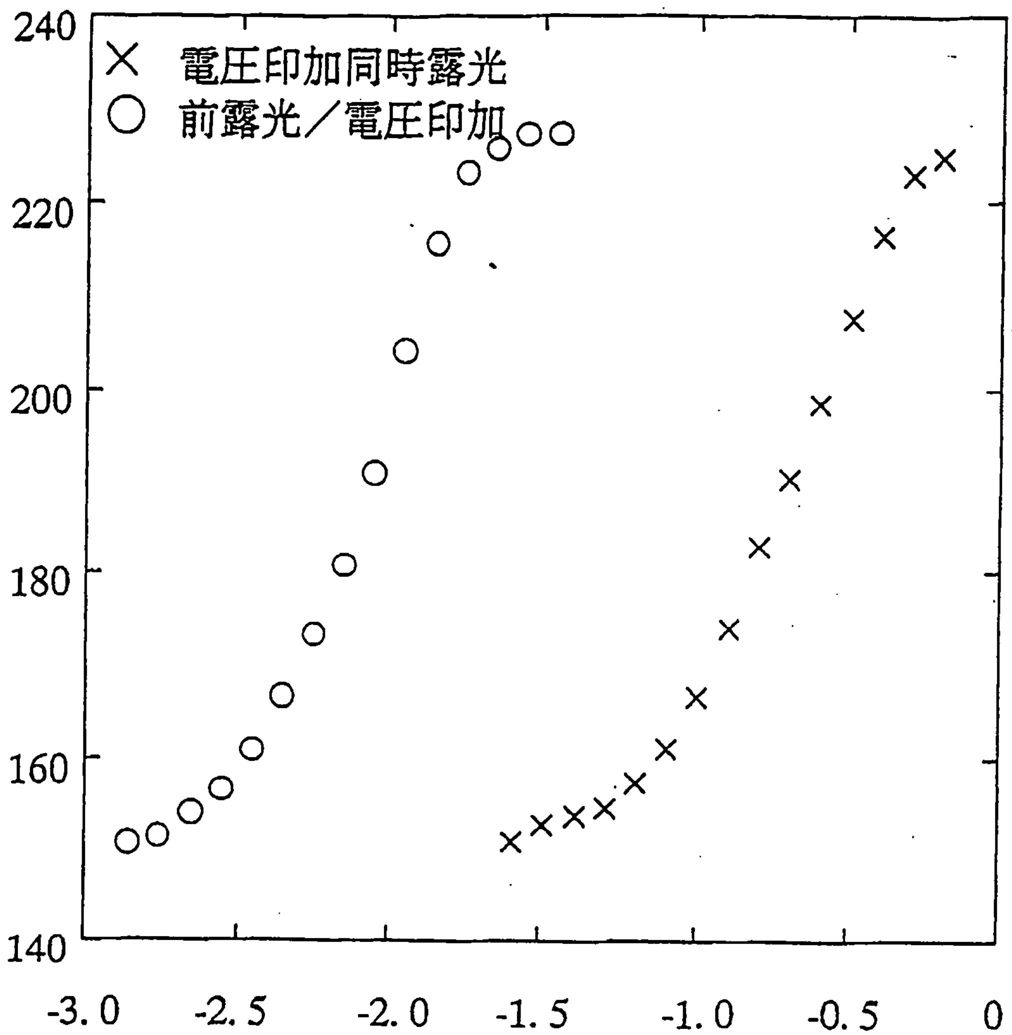


図34

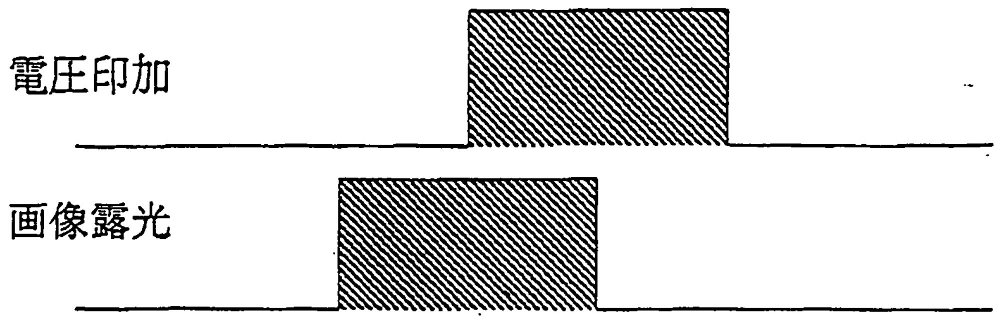

電圧印加
画像露光

図35

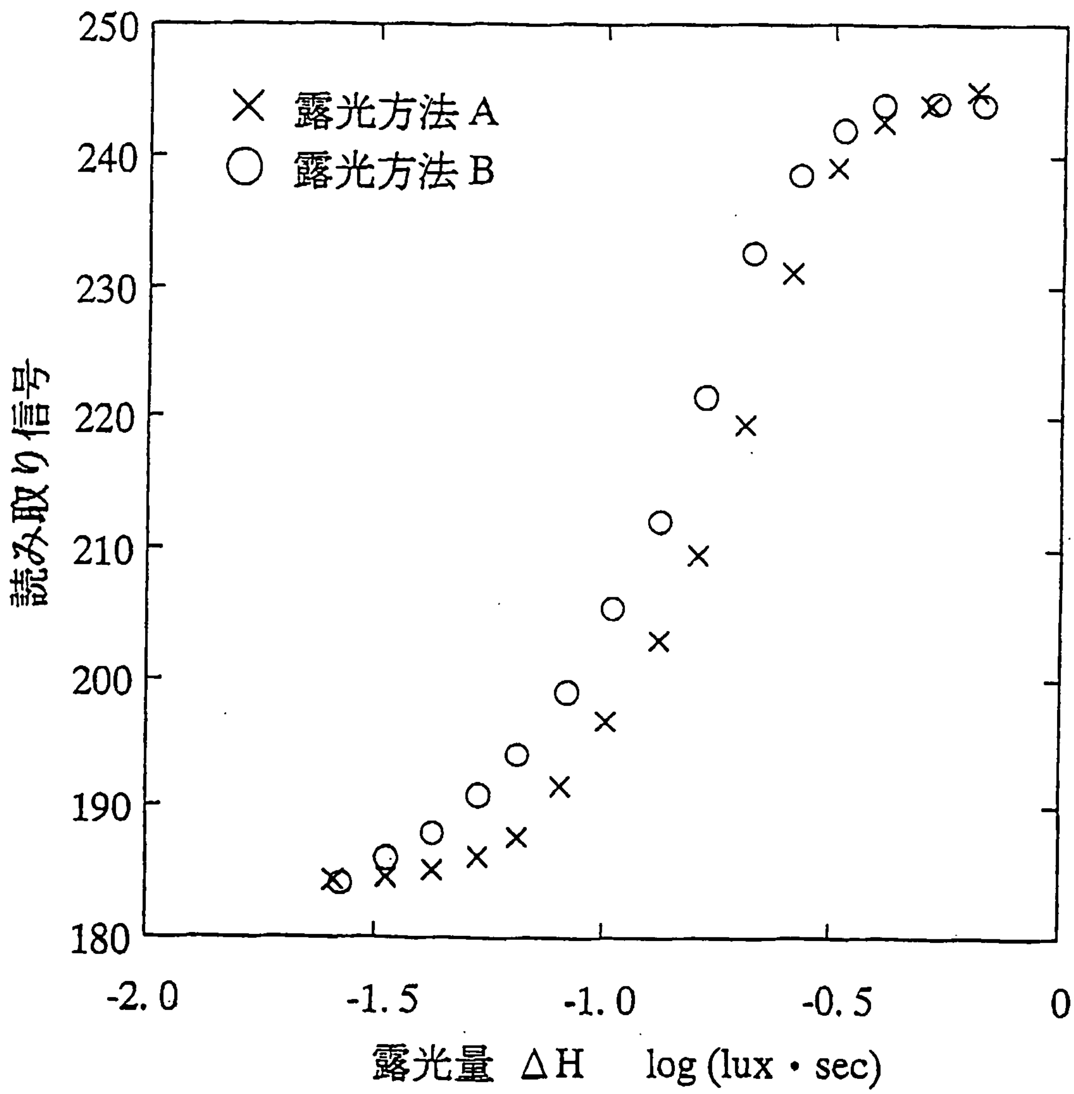

250
240
230
220
210
200
190
180
露光方法 A
露光方法 B
読み取り信号
-2.0
-1.5
-1.0
-0.5
0
露光量 ΔH log (lux・sec)

図36

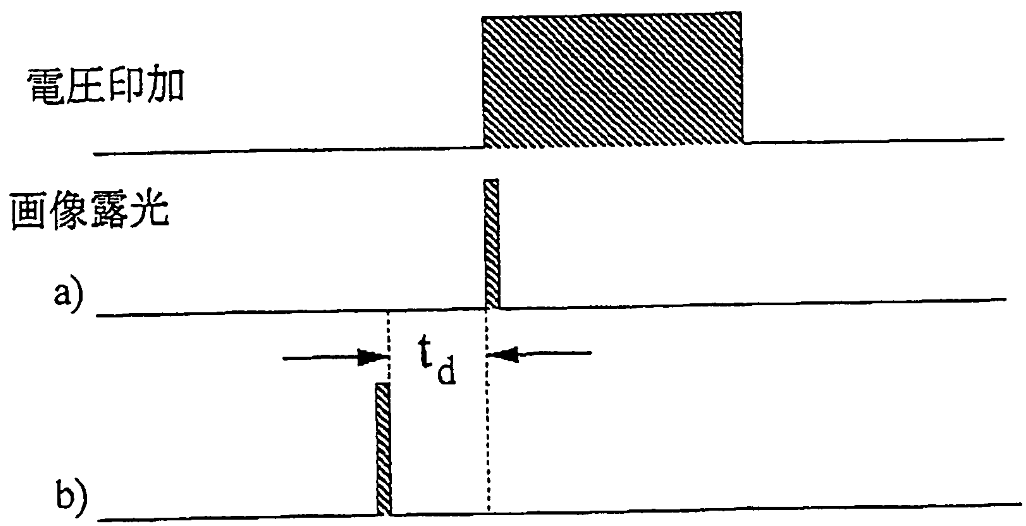
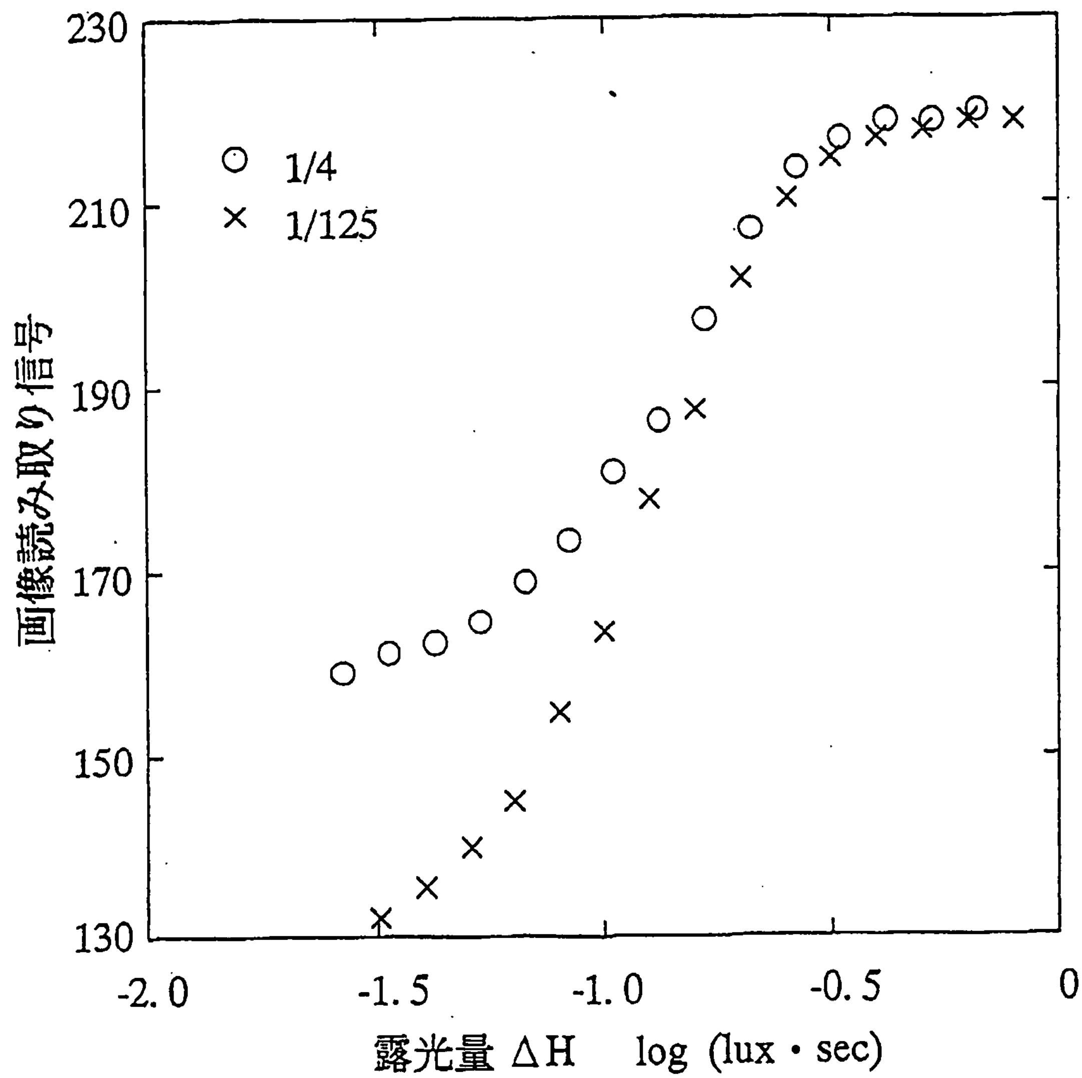


図37



230
210
190
170
150
130
1/4
1/125
画像読み取り信号
-2.0
-1.5
-1.0
-0.5
0
露光量 ΔH log (lux・sec)

図38

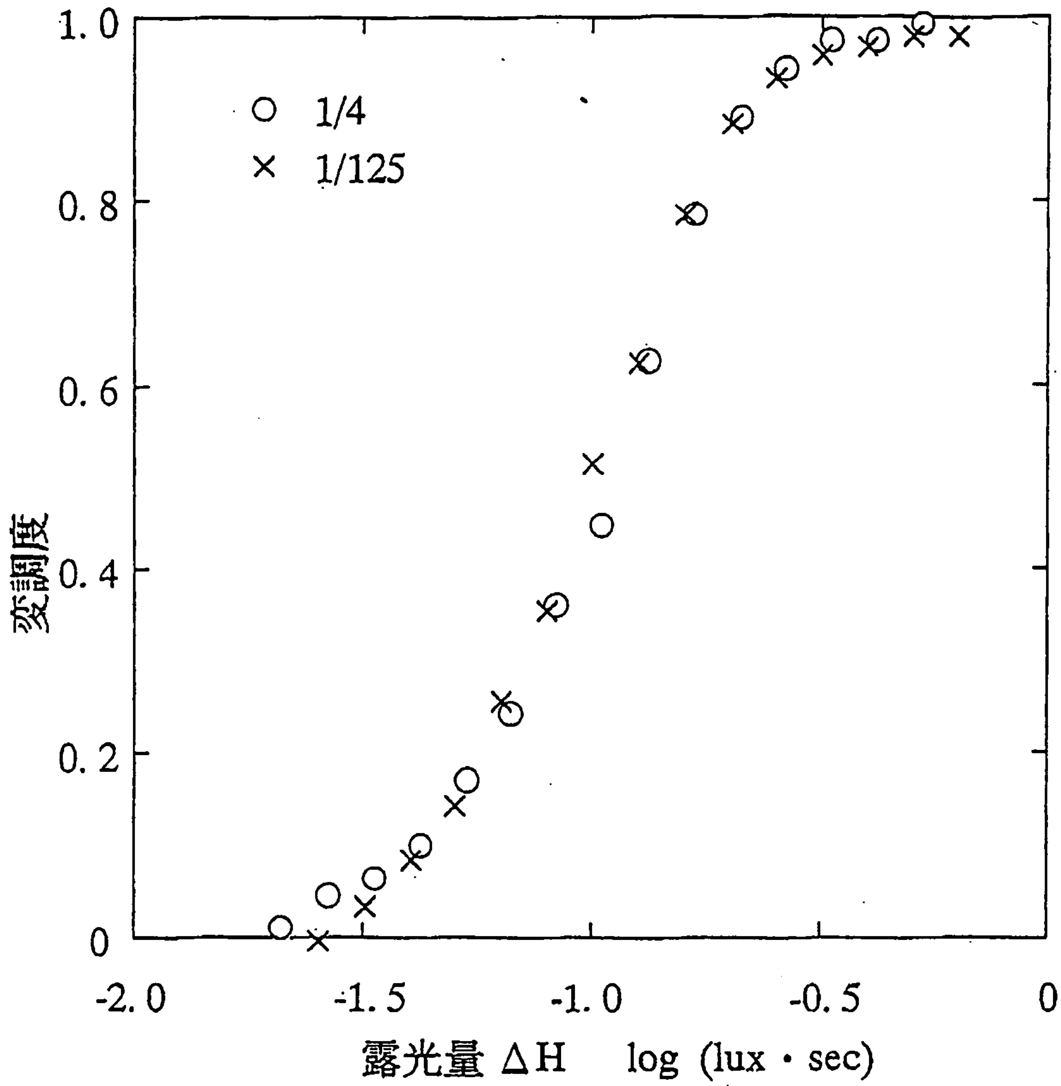


図39

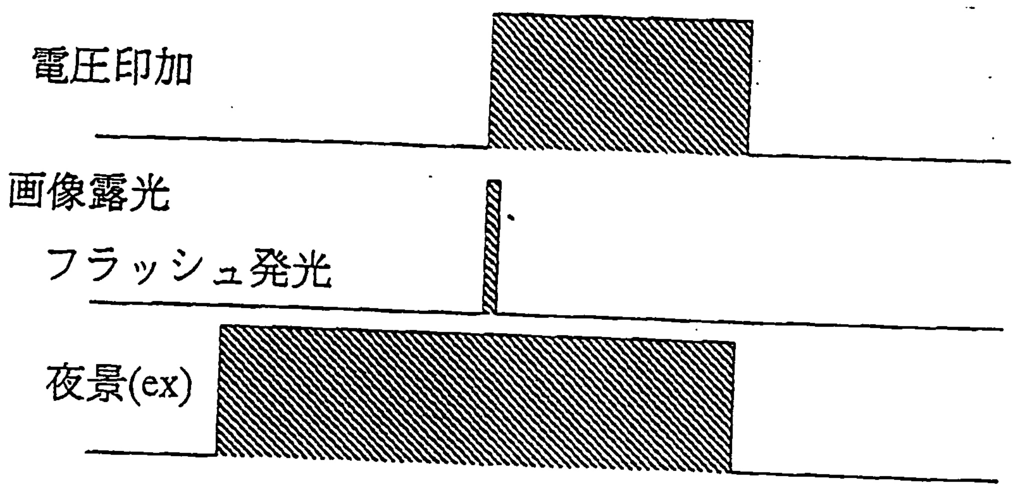


図40

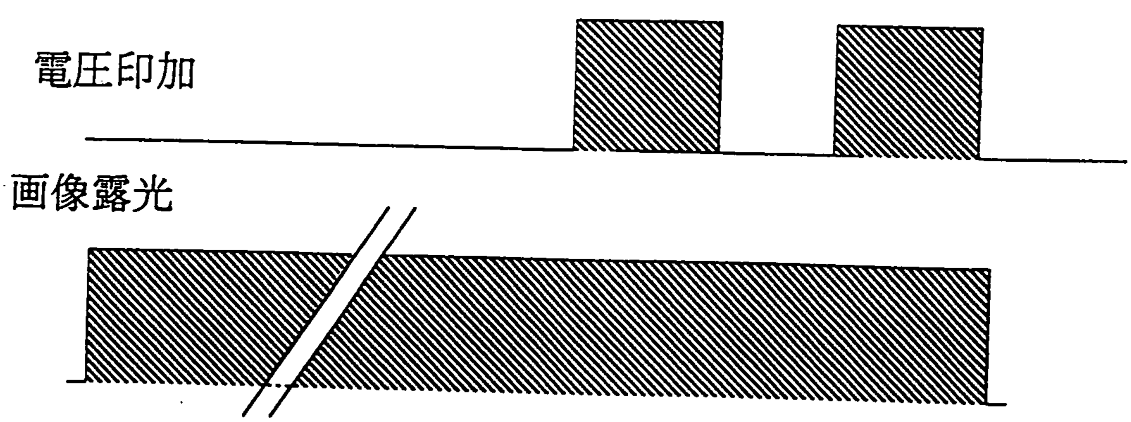


図41

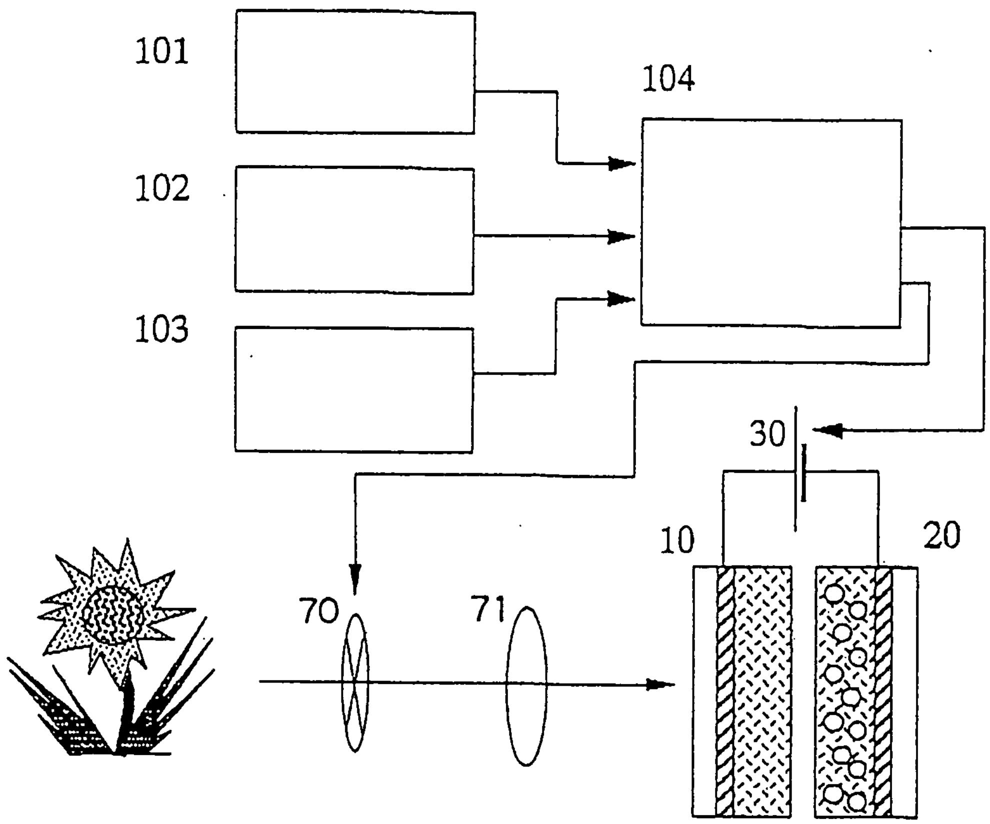


図42

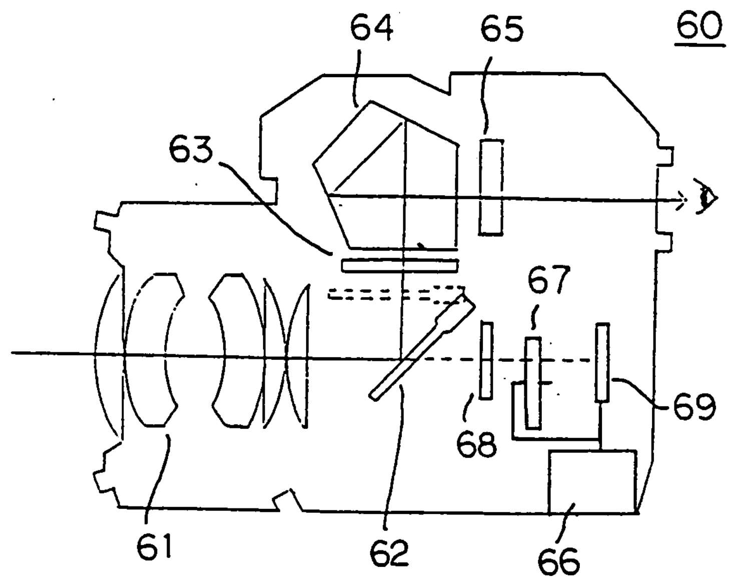

64
65
60
63
67
69
68
61
62
66

図43

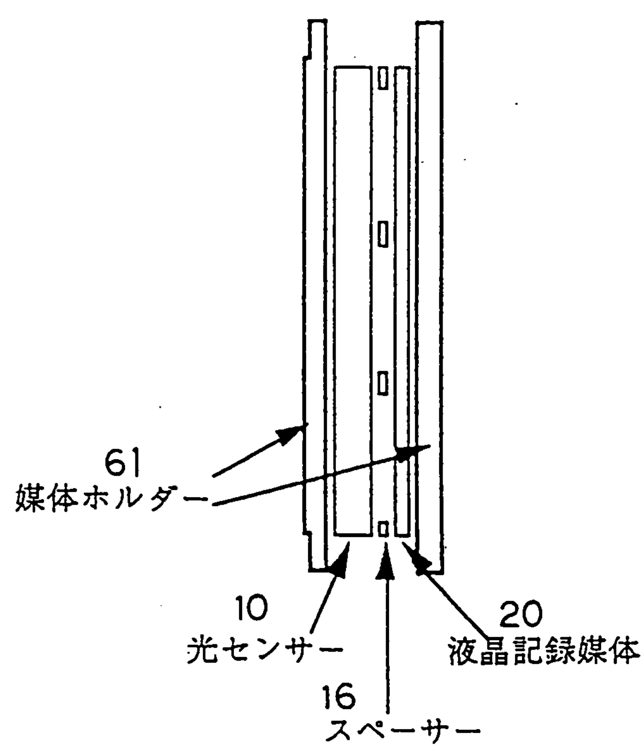

61
媒体ホルダー
10
光センサー
20
液晶記録媒体
16
スペーサー

図44

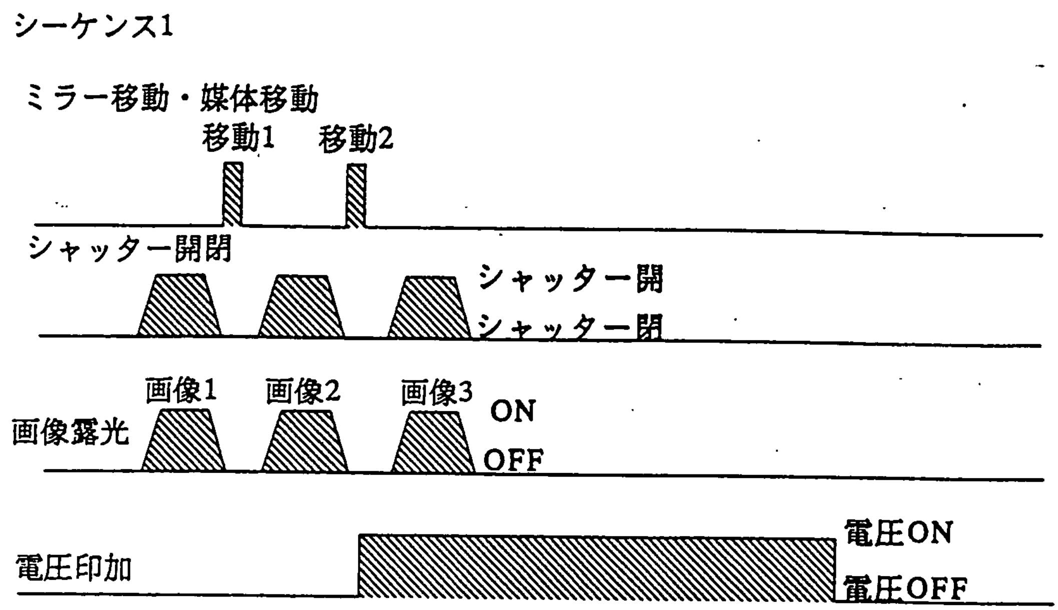

シーケンス1
ミラー移動・媒体移動
移動1
移動2
シャッター開閉
シャッター開
シャッター閉
画像1
画像2
画像3
画像露光
ON
OFF
電圧印加
電圧ON
電圧OFF

図45

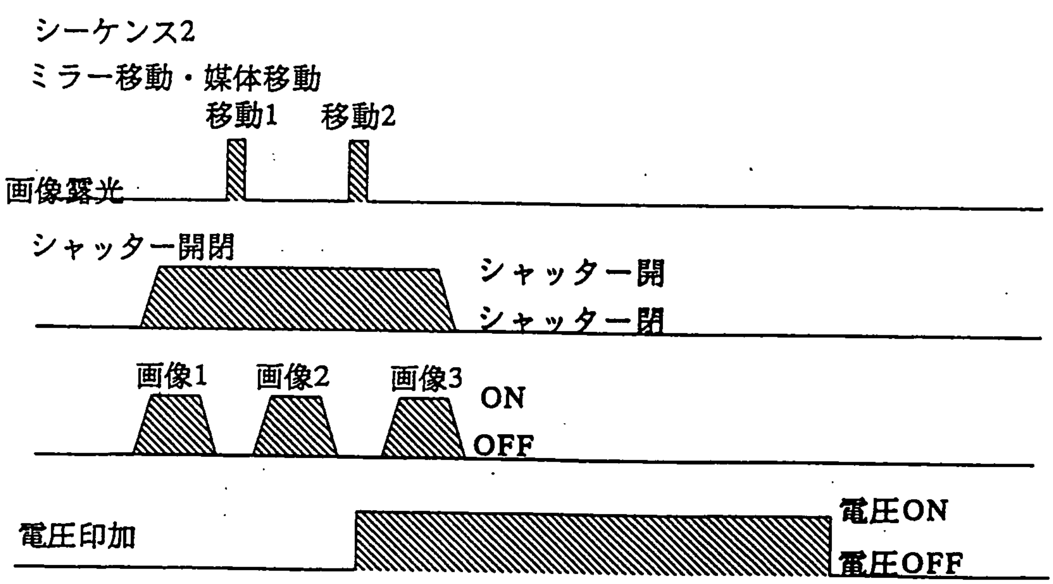
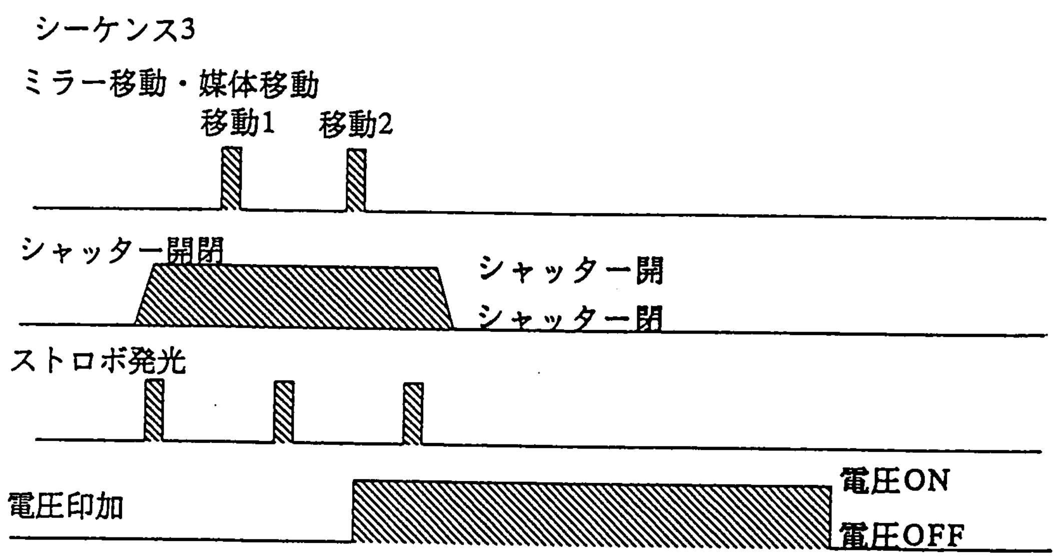

シーケンス2
ミラー移動・媒体移動
移動1
移動2
画像露光
シャッター開閉
シャッター開
シャッター閉
画像1
画像2
画像3
ON
OFF
電圧印加
電圧ON
電圧OFF

図46


シーケンス3
ミラー移動・媒体移動
移動1
移動2
シャッター開閉
シャッター開
シャッター閉
ストロボ発光
電圧印加
電圧ON
電圧OFF

EXPRESS MAIL LABEL EG 297333548 US

Case No. 2122-4028 Serial No. To be assigned

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Date Due in the Patent Office 27 April 1995
(Priority Date)

The return of this post card, properly stamped, will acknowledge receipt in the Patent & Trademark Office of the following: In re new patent applicatin of OKABE

1.- Application fee transmittal;
2.- 38 pp spec (in the Japanese language) 18 claims; 1 Abstract and 29 sheets of informal drawings
3.- (Figs. 1-46);
4.- Check#3322 for $882. (filing fee);
5.- Certificate under 37 C.F.R. 1.10; and
6.- Return Postcard.

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SN 08/428,325
filed 4/25/95

EXPRESS MAIL LABEL EG 297333548 US

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3.- 1 Abstract and 29 sheets of informal drawings (Figs. 1-46);

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CASE 2122-4028 ATTY C. E. Chalsen

INFORMATION DISCLOSURE STATEMENT July 25, 1995

FOREIGN FILING ~~Oct. 25, 1995~~

CONVENTION DATE EXPIRES ~~April 25, 1996~~

N/A

SN 08/428,325
filed 4/25/95

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CASE 2122-4028 ATTY C. E. Chalsen

INFORMATION DISCLOSURE
STATEMENT July 25, 1995

FOREIGN FILING ~~Oct. 25, 1995~~

CONVENTION DATE EXPIRES ~~April 25, 1996~~

N/A

PATENT
DOCKET NO.: 2122-4028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF EXPRESS MAIL (37 C.F.R § 1.10)

Inventors : Masato OKABE

Title : PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD, AND INFORMATION RECORDING SYSTEM

Serial No. : To be Assigned

Filing Date : April 25, 1995

Express Mail Label No. EG 297333548 US
Date of Deposit: April 25, 1995

I hereby certify that the following attached papers and fees

1. Application Fee Transmittal;
2. 38 pp. of Specification (in the Japanese language), 3 pp. 18 Claims; 1p. Abstract; and 29 sheets of Formal Drawings (Figs. 1-46);
3. Check in the amount of $882 for the filing fee; and
4. Return Postcard.

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SARA E. MEADOR
Printed or typed name of person mailing paper(s) or fee)

Sara E. Meador 4/25/95
(Signature of person mailing paper(s) or fee)

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NO DELIVERY
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Christopher E. Chalsen, Esq.
MORGAN & FINNEGAN
345 Park Ave.
NY NY 10154

Atty Docket No.: 2122-4028

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ATTENTION: BOX PATENT APPLICATION

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CORRESPONDENCE #2

FILE DATE June 25, 1995
STATUTORY DATE October 25, 1995
BY KB

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Patent and Trademark Office
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APPLICATION NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
08/428,325	04/25/95	OKABE	2122-4028

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M

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MORGAN AND FINNEGAN
345 PARK AVENUE
NEW YORK NY 10154

MORGAN & FINNEGAN

DATE MAILED: 0000

05/18/95

NOTICE TO FILE MISSING PARTS OF APPLICATION
FILING DATE GRANTED

An Application Number and Filing Date have been assigned to this application. However, the items indicated below are missing. The required items and fees identified below must be timely submitted **ALONG WITH THE PAYMENT OF A SURCHARGE** for items 1 and 3-6 only of $ 130 for large entities or $ 65 for small entities who have filed a verified statement claiming such status. The surcharge is set forth in 37 CFR 1.16(e).

If all required items on this form are filed within the period set below, the total amount owed by applicant as a ☑ large entity, ☐ small entity (verified statement filed), is $ 260.

Applicant is given **ONE MONTH FROM THE DATE OF THIS LETTER, OR TWO MONTHS FROM THE FILING DATE** of this application, **WHICHEVER IS LATER,** within which to file all required items and pay any fees required above to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

1. ☐ The statutory basic filing fee is: ☐ missing ☐ insufficient. Applicant as a ☐ large entity ☐ small entity, must submit $________ to complete the basic filing fee.

2. ☐ Additional claim fees of $________ as a ☐ large entity, ☐ small entity, including any required multiple dependent claim fee, are required. Applicant must submit the additional claim fees or cancel the additional claims for which fees are due.

3. ☑ The oath or declaration:
   ☑ is missing.
   ☐ does not cover the newly submitted items.

   An oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date is required.

4. ☐ The oath or declaration does not identify the application to which it applies. An oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.

5. ☐ The signature(s) to the oath or declaration is/are: ☐ missing; ☐ by a person other than the inventor or a person qualified under 37 CFR 1.42, 1.43, or 1.47. A properly signed oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.

6. ☐ The signature of the following joint inventor(s) is missing from the oath or declaration:

   __________ An oath or declaration listing the names of all inventors and signed by the omitted inventor(s), identifying this application by the above Application Number and Filing Date, is required.

7. ☑ The application was filed in a language other than English. Applicant must file a verified English translation of the application and a fee of $ 130 under 37 CFR 1.17(k), unless this fee has already been paid.

8. ☐ A $________ processing fee is required since your check was returned without payment. (37 CFR 1.21(m)).

9. ☐ Your filing receipt was mailed in error because your check was returned without payment.

10. ☐ The application does not comply with the Sequence Rules. See attached Notice to Comply with Sequence Rules 37 CFR 1.821-1.825.

11. ☐ Other.

Direct the response to Box Missing Part and refer any questions to the Customer Service Center at (703) 308-1202.

A copy of this notice MUST be returned with the response.

FORM PTO-1533 (REV. 11-94)   ATTORNEY'S COPY

CORRESPONDENCE #3

PATENT

Docket No. 2122-4028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s) : Masato Okabe

Serial No. : 08/428,325

Filed : April 25, 1995

For : PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD, AND INFORMATION RECORDING SYSTEM

RESPONSE TO NOTICE TO FILE MISSING PARTS

Assistant Commissioner of Patents
BOX MISSING PARTS
Washington, D.C. 20231

Sir:

This paper is submitted in response to the Notice to File Missing Parts of Application issued May 18, 1995.

Applicant submits herewith: (1) a properly signed declaration in compliance with 37 CFR 1.63, identifying the application by serial number and filing date; and (2) a verified English translation of the application.

A copy of the Notice to File Missing Parts of Application is also enclosed herewith, along with a check for $260.00 for filing this response ($130.00 for the signed declaration and $130.00 for the verified English translation). In addition, a petition and fee of $370.00 for a two-month extension of time for filing this response is filed concurrently herewith.

The Commissioner is hereby authorized to charge Deposit Account No. 13-4500, Charge No. 2122-4028 for any underpayment associated with filing this response.

Respectfully submitted,

MORGAN & FINNEGAN, L.L.P.

Dated: August 16, 1995

By: Bruce D. DeRenzi
Bruce D. DeRenzi
Registration No. 33,676
(212) 415-8750 (Direct)

Mailing Address:

MORGAN & FINNEGAN, L.L.P.
345 Park Avenue
New York, New York 10154
(212) 758-4800
(212) 758-6849 (Telecopier)

COMBINED DECLARATION AND POWER OF ATTORNEY FOR ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL, DIVISIONAL, CONTINUATION OR CONTINUATION-IN-PART APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD, AND INFORMATION RECORDING SYSTEM

the specification of which

a. [ ] is attached hereto

b. [X] was filed on April 25, 1995 as application Serial No. 08/428,325 and was amended on ______________________. (if applicable).

PCT FILED APPLICATION ENTERING NATIONAL STAGE

c. [ ] was described and claimed in International Application No. ________ filed on ________ and as amended on ____________. (if any).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, § 1.56(a).

[X] I hereby claim foreign priority benefits under Title 35, United States Code § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

[X] The attached 35 U.S.C. § 119 claim for priority for the U.S. application(s) listed below forms a part of this declaration.

Country	Application Number	Date of filing (day, month, yr)	Date of issue (day, month, yr)	Priority Claimed
Japan	089489	27 April 1994		[X] YES [ ] NO
Japan	091030	17 April 1995		[X] YES [ ] NO

ADDITIONAL STATEMENTS FOR DIVISIONAL, CONTINUATION OR CONTINUATION-IN-PART

I hereby claim the benefit under Title 35, United States Code § 120 of any United States application(s) listed below.

Application Serial No.	Filing Date,	Status (patented, pending, abandoned)

Application Serial No.	Filing Date,	Status (patented, pending, abandoned)

[ ] In this continuation-in-part application, insofar as the subject matter of any of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or Imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

I hereby appoint the following attorneys and/or agents with full power of substitution and revocation, to prosecute this application, to receive the patent, and to transact all business in the Patent and Trademark Office connected therewith: John D. Foley (Reg. No. 16,836), John A. Diaz (Reg. No. 19,550), Thomas P. Dowling (Reg. No. 19,221), John C. Vassil (Reg. No. 19,098), Warren H. Rotert (Reg. No. 19,659), Alfred P. Ewert (Reg. No. 19,887), David H. Pfeffer, P.C. (Reg. No. 19,825), Harry C. Marcus (Reg. No. 22,390), Robert E. Paulson (Reg. No. 21,046), Stephen R. Smith (Reg. No. 22,615), Kurt E. Richter (Reg. No. 24,052), J. Robert Dailey (Reg. No. 27,434), Eugene Moroz (Reg. No. 25,237), John F. Sweeney (Reg. No. 27,471), Arnold I. Rady (Reg. No. 26,601), Christopher A. Hughes (Reg. No. 26,914), William S. Feiler (Reg. No. 26,728), Joseph A. Calvaruso (Reg. No. 28,287), James W. Gould (Reg. No. 28,859), Richard C. Komson (Reg. No. 27,913), Israel Blum (Reg. No. 26,710), Bartholomew Verdirame (Reg. No. 28,483), Maria C. H. Lin (Reg. No. 29,323), Joseph A. DeGirolamo (Reg. No. 28,595), Christopher E. Chalsen (Reg. No. 30,936), Michael A. Nicodema (Reg. No. 33,199) and Michael P. Dougherty (Reg. No. 32,730) of Morgan & Finnegan, L.L.P., whose address is: 345 Park Avenue, New York, New York 10154.

[ ] I hereby authorize the U.S. attorneys and/or agents named hereinabove to accept and follow instructions from ______________________________ ___________ as to any action to be taken in the U.S. Patent and Trademark Office regarding this application without direct communication between the U.S. attorneys and/or agents and me. In the event of a change in the person(s) from whom instructions may be taken I will so notify the U.S. attorneys and/or agents named hereinabove.

I hereby specify the following as the correspondence address to which all communications about this application are to be directed:

SEND CORRESPONDENCE TO: CHRISTOPHER E. CHALSEN

MORGAN & FINNEGAN, L.L.P., 345 Park Avenue, New York, N.Y. 10154

DIRECT TELEPHONE CALLS TO: CHRISTOPHER E. CHALSEN
(212) 415-8516

Full name of sole or first inventor Masato Okabe

Inventor's signature* Masato Okabe June 2, 1994
date

Residence: c/o Dai Nippon Printing Co., Ltd., 1, Ichigaya-Kagacho 1-chome, Shinjuku-ku, Tokyo, 162 JAPAN

Citizenship: Japanese

Post Office Address: c/o Dai Nippon Printing Co., Ltd., 1, Ichigaya-Kagacho 1-chome, Shinjuku-ku,
Tokyo, 162 JAPAN

Full name of second joint inventor, if any ______

Inventor's signature* ______
date

Residence ______

Citizenship ______

Post Office Address ______

[X] ATTACHED IS ADDED PAGE TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR SIGNATURE BY THIRD AND SUBSEQUENT INVENTORS FORM.

* Before signing this declaration, each person signing must:

1. Review the declaration and verify the correctness of all information therein; and

2. Review the specification and the claims, including any amendments made to the claims.

After the declaration is signed, the specification and claims are not to be altered.

To the inventor(s):

The following are cited in or pertinent to the declaration attached to the accompanying application:

Title 37, Code of Federal Regulation, §1.56

Duty to disclose information material to patentability

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclose information exists with respect to each pending claim until the claim is canceled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is canceled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) the closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

Title 35, U.S. Code § 101

Inventions patentable

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

Title 35 U.S. Code § 102

Conditions for patentability; novelty and loss of right to patent

A person shall be entitled to a patent unless --

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent,

(b) the invention was patented or described in a printed publication in this or foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States, or

(c) he has abandoned the invention, or

(d) the invention was first patented or caused to be patented, or was the subject of an inventor's certificate, by the applicant or his legal representatives or assigns in a foreign country prior to the date of the application for patent in this country on an application for patent or inventor's certificate filed more than twelve months before the filing of the application in the United States, or

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another

who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent, or

(f) he did not himself invent the subject matter sought to be patented, or

(g) before the applicant's invention thereof the invention was made in this country by another who had not abandoned, suppressed, or concealed it. In determining priority of invention there shall be considered not only the respective dates of conception and reduction to practice of the invention, but also the reasonable diligence of one who was first to conceive and last to reduce to practice, from a time prior to conception by the other ...

<u>Title 35, U.S. Code § 103</u>

Conditions for patentability; non-obvious subject matter

A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Subject matter developed by another person, which qualifies as prior art only under subsection (f) or (g) of section 102 of this title, shall not preclude patentability under this section where the subject matter and the claimed invention were, at the time the invention was made, owned by the same person or subject to an obligation of assignment to the same person.

<u>Title 35, U.S. Code § 112 (in part)</u>

Specification

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

<u>Title 35, U.S. Code, § 119</u>

Benefit of earlier filing date in foreign country; right of priority

An application for patent for an invention filed in this country by any person who has, or whose legal representatives or assigns have, previously regularly filed an application for a patent for the same invention in a foreign country which affords similar privileges in the case of applications filed in the United States or to citizens of the United States, shall have the same effect as the same application would have if filed in this country on the date on which the application for patent for the same invention was first filed in such foreign country, if the application in this country is filed within twelve months from the earliest date on which such foreign application was filed; but no patent shall be granted on any application for patent for an invention which had been patented or described in a printed publication in any country more than one year before the date of the actual filing of the application in this country, or which had been in public use or on sale in this country more than one year prior to such filing.

<u>Title 35, U.S. Code, § 120</u>

Benefit or earlier filing date in the United States

An application for patent for an invention disclosed in the manner provided by the first paragraph of section 112 of this title in an application previously filed in the United States, or as provided by section 363 of this title, which is filed by an inventor or inventors named in the previously filed application shall have the same effect, as

to such invention, as though filed on the date of the prior application, if filed before the patenting or abandonment of or termination of proceedings on the first application or an application similarly entitled to the benefit of the filing date of the first application and if it contains or is amended to contain a specific reference to the earlier filed application.

Please read carefully before signing the Declaration attached to the accompanying Application.

If you have any questions, please contact Morgan & Finnegan, L.L.P.

FORM: COMB-DEC.NY

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	:	Masato OKABE	Examiner: To be assigned
Serial No.	:	08/428,325	Art Unit: To be assigned
Filed	:	April 25, 1995	
Title	:	PHOTOELECTRIC SENSOR INFORMATION RECORDING METHOD AND INFORMATION RECORDING SYSTEM	

The Honorable Commissioner of Patent and Trademarks
Washington, D.C. 20231

DECLARATION PURSUANT TO 37 C.F.R. § 1.52(d)

Sir:

I, Masaharu ISHIDA, hereby delare that the English translation attached herewith to the above-identified application is a literal translation thereof pursuant to 37 C.F.R. § 1.52(d).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Dated: June 7, 1995

By: M. Ishida

TITLE OF THE INVENTION

PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD, AND INFORMATION RECORDING SYSTEM

BACKGROUND OF THE INVENTION

The present invention relates to an information recording system comprising an information recording medium and a photoelectric sensor capable of recording light information on the information recording medium in the form of visible information or electrostatic information. More particularly, the present invention relates to a photoelectric sensor including a photoconductive layer that enables the ability of an information recording medium to record information to be noticeably amplified as well as an information recording method and system that uses this photoelectric sensor.

There has so far been an information recording and reproducing method in which a photoelectric sensor having a photoconductive layer provided with an electrode on the front side is opposed, on the optical axis, to an information recording medium having an electric charge retaining layer provided with an electrode on the rear side thereof, and the sensor is exposed to light with voltage being applied between the two electrodes, thereby enabling electrostatic charge corresponding to the incident optical image to be recorded on the electric charge retaining layer, and then the recorded electrostatic information is reproduced by toner development or electric potential reading method, as typically described in JP-A 1-290366 and 1-289975. There is another conventional information recording and reproducing method in which the

electric charge retaining layer used in the above-described method is replaced by a thermoplastic resin layer, and after electrostatic charge has been recorded on the surface of the thermoplastic resin layer, heating is carried out to form a frost image on the surface of the thermoplastic resin layer, thereby making the recorded electrostatic charge visible, as typically described in JP-A 3-192288.

Applicants have already filed Japanese Patent Application Nos. 4-173030 and 5-101277 in which there is claimed an information recording and reproducing method wherein the information recording layer used in the above information recording medium is formed of a liquid crystal-polymer composite material layer. As mentioned above, the photoelectric sensor is exposed to light at an applied voltage to align the liquid crystals of the liquid crystal layer by an electric field created by the photoelectric sensor, thereby recording information on the recording medium. The thus recorded information is reproduced in the form of visible information by transmitted or reflected light. With this information recording and reproducing method, it is possible to make the recorded information visible without recourse to a polarizing plate.

In the information recording method using such a photoelectric sensor and an information recording layer comprising a liquid crystal phase, incident information light is directed to the sensor with voltage applied between the electrodes. Thereupon, photocarriers are generated in the photoconductive layer at the portion on which the light is

incident. Then, the photocarriers are moved by an electric field created by both electrodes, resulting in the redistribution of the voltage. Thus, the liquid crystals in the liquid crystal phase of the information recording layer are aligned, thereby recording the information according to the pattern of information light. Upon a continued application of voltage even after the exposure of the photoelectric sensor to information light has been finished, the sensor shows a sustained conductivity so that the recording of the information on the information recording layer can be continued. The operating voltage and its range vary with liquid crystals. Thus, when the voltage to be applied and the voltage applying time are to be predetermined, it is preferable to make proper determination of the voltage distribution in the information recording medium so that the voltage distributed to the information recording layer can be set within the operating voltage range of the liquid crystal used. This recording method makes planar analog recording possible, and enables information to be recorded with high resolution. The exposure pattern is retained in the form of a visible image by the alignment of the liquid crystals in the liquid crystal phase.

A camera or laser may be used for recording information. When the camera is used, the information recording medium is used in place of photographic film used with an ordinary camera. In this case, either an optical shutter or an electrical shutter may be used. For color photography, light information is separated through a combined prism and color

filter into R, G and B light components in the form of parallel beams, which are in turn recorded on three R, G and B information recording media to form one frame. Alternatively, the R, G and B images may be recorded on three discrete regions of one information recording medium to form one frame.

Reference is here made to, for instance, a photoelectric sensor including a bisazo pigment-containing photoconductive layer on an ITO film formed on a glass substrate. Fig. 1 is a current vs. time graph of this photoelectric sensor when it is exposed to 20-lux green light at an applied voltage of 200 volts. The exposed portion L1 is more increased in conductivity than the unexposed portion L2. Fig. 2 is a simulated voltage vs. time graph for the exposed and unexposed portions of a liquid crystal recording layer of an information recording medium made up of liquid crystals, when the information recording medium is taken as a parallel circuit comprising a capacitor and a resistance. Since the exposed portion is higher in conductivity than the unexposed portion, the voltage applied to the liquid crystal layer is much more increased, so that the liquid crystals at the exposed portion can be aligned to record an image.

Therefore, unless the conductivity difference between the exposed and unexposed portions shown in Fig. 1 reaches a certain value, it is then impossible to record an image of good quality on the liquid crystal recording medium.

When voltage is applied to the photoelectric sensor and liquid crystal recording medium in such a way, there are the

optimum values for the voltage applying time and applied voltage. For instance, when the voltage applying time is too long, no image can be recorded on the liquid crystal recording medium, because the liquid crystals at the unexposed portion are aligned, too.

The voltage applying time may be extended by lowering the applied voltage. At too low an applied voltage, however, no image can again be recorded because the voltage of the liquid crystal recording medium at the unexposed portion does not reach the threshold voltage.

As described above, it is required that when information is recorded, the application of voltage be finished within a prescribed time; that is, no effective recording of information is achieved even when the application of voltage is continued after an elapse of that time.

In most cases, the voltage applying time, albeit varying depending on the characteristics of an photoelectric sensor or an information recording medium, is within 200 milliseconds, often within about 30 milliseconds to about 50 milliseconds. The voltage applying time is predominantly determined by the current value of the unexposed portion, and is hardly dependent on exposure intensity and exposure time.

With silver halide photography that enables images to be recorded over a wide range of light intensity, it is possible to record an image of good quality by extending exposure time even when an image of low exposure intensity is recorded. Unless conditions are very severe, images of similar quality can be obtained either when film is exposed to weak light for

a long time or when film is exposed to intense light for a short time; that is, the reciprocity law can apply.

Fig. 3 is a current vs. time graph when a photoelectric sensor is exposed to 6-lux light for 200 milliseconds at an applied voltage of 200 volts, and Figs. 4 and 5 show current value differences between the exposed and unexposed portions when the photoelectric sensor is exposed to 6-lux light and 20-lux light, respectively.

When the photoelectric sensor is exposed to light at an intensity of 6 luxes, a photo-induced current corresponding to the difference between the unexposed and exposed portions can be obtained by continuing exposure for an extended time at much the same level as can be achieved by exposure at 20 luxes, as can be seen from Fig. 4.

However, such a photoelectric sensor cannot be used to record information by a prior art recording method wherein the application of voltage is started at the same time as exposure. The reason is that the voltage applying time (the time taken for the unexposed portion to reach the threshold voltage) is about 30 milliseconds to about 50 milliseconds. Within such a short time, it is impossible to record an image of good quality, because the current value obtained by exposure at 6 luxes is smaller than that by exposure to 20-lux light.

With such a conventional method, no information can be recorded at a low exposure intensity. This is true of even when voltage is applied to the photoelectric sensor until the

voltage of the unexposed portion reaches the threshold voltage.

The latitude of the recorded image often becomes narrow, although depending on voltage applying conditions. In this case, no sufficient expression of the subject is achieved due to some problems inclusive of washed-out highlights and flat shadow areas.

In silver halide photography that is the most generally used image recording method, the reciprocity law can apply over a wide range. For instance, if the diaphragm is opened (or exposure intensity is enhanced) and the shutter is clicked at high speed, it is then possible to bring only a specific portion of the subject into focus and thereby shade off other portion of the subject. On the contrary, if the shutter is clicked at low speed upon the diaphragm stopped down, it is then possible to bring a wide range including the subject into focus. Thus, the reciprocity law can be satisfied by controlling shutter speed and f-number so that the same exposure quantity can be achieved. Furthermore, if shutter speed is changed depending on exposure intensity, the same film can then be used to take a shot of an outdoor scene on a fine day or a night scene.

When an image is recorded using the system of the present invention comprising a photoelectric sensor and a liquid crystal medium, however, the reciprocity law needed for photography fails, because no image can be recorded on the liquid crystal medium even when the exposure of the sensor to image light is continued after an elapse of the

voltage applying time; that is, the sensor cannot be exposed to light over an extended period of time. Nor can the reciprocity law apply even in a region where exposure time is extremely short. Thus, such reciprocity law failure offers problems when photographs of various subjects are taken under diverse conditions.

SUMMARY OF THE INVENTION

One object of the present invention is to enable information to be recorded on an information recording medium by an extended exposure when exposure intensity is low.

Another object of the present invention is to enable images to be recorded over a wide latitude range.

Still another object of the present invention is to enable various pieces of image information in a region where the reciprocity law fails to be recorded under diverse conditions by compensating for reciprocity law failures.

Throughout the disclosure, the "image information" is understood to mean image-bearing information. Likewise, the "information or image light" is understood to refer to information- or image-bearing light.

According to one aspect of the present invention, there is provided a photoelectric sensor including a photoconductive layer on an electrode and used to record information on an information recording medium, characterized in that when voltage is applied to said sensor after said sensor has been exposed to light with no voltage applied thereto or voltage of opposite polarity applied thereto, a photo-induced current is generated depending on exposure

quantity so that the information can be recorded on said information recording medium.

According to another aspect of the present invention, there is provided a photoelectric sensor including a photoconductive layer on an electrode and used to record information on an information recording medium, characterized in that said sensor is exposed to information light with voltage applied thereto, whereby the exposed portion is made higher in conductivity than the unexposed portion and the exposed portion is kept still higher in conductivity than the unexposed portion even after the exposure of said sensor to information light has been finished, and while said sensor remains exposed to information light or after the exposure of said sensor to information light has been finished, the application of voltage thereto is interrupted or voltage of opposite polarity is applied thereto, and then the original voltage is again applied thereto, whereby the resulting conductivity is made equal to that obtained by the continued application of voltage.

Preferably, the present invention is further characterized in that when an electric field of 10^5 to 10^6 V/m is applied to the photoelectric sensor, a current passing through the unexposed portion has a current density of 10^{-4} to 10^{-7} A/cm^2.

According to a further aspect of the present invention, there is provided an image recording method wherein light information is recorded on an information recording medium by exposure to light information, characterized by use of the

above-defined photoelectric sensor and an information recording medium having an information recording layer formed on an electrode,

the electrode of at least one of said photoelectric sensor and said information recording medium being a transparent electrode, and

said photoelectric sensor being opposed to said information recording medium on the optical axis with a gap located therebetween, or said photoelectric sensor and said information recording medium being stacked on each other with or without a dielectric interlayer located therebetween,

so that after said sensor has been exposed to light information or while said sensor is being exposed to light information, the application of voltage between both said electrodes is started.

Preferably, the present invention is further characterized in that the above information recording medium is a liquid crystal recording medium including on an electrode a liquid crystal-polymer composite material layer comprising liquid crystals and resin.

Preferably, the present invention is further characterized in that after an elapse of a certain time upon the exposure of the photoelectric sensor to light information finished, the application of voltage to both electrodes is started. thereby making the latitude of the recorded image wide.

Preferably, the present invention is further characterized in that the period of time from the finish of

the exposure of the photoelectric sensor to light information to the start of the application of voltage to both electrodes is 0 to 500 milliseconds.

According to a still further aspect of the present invention, there is an image recording method wherein light information is recorded on an information recording medium by exposure to information light, characterized by use of the above-defined photoelectric sensor and an information recording medium including an information recording layer formed on an electrode,

the electrode of at least one of said photoelectric sensor and said information recording medium being a transparent electrode, and

said photoelectric sensor being opposed to said information recording medium on the optical axis with a gap located therebetween, or said photoelectric sensor and said information recording medium being stacked on each other with or without a dielectric interlayer located therebetween,

so that said sensor is exposed to light information, and while said sensor is being exposed to light information or after said sensor has been exposed to light information, the period of time wherein no voltage is applied to both said electrodes or the period of time wherein voltage of opposite polarity is applied to both said electrodes is provided.

According to a still further aspect of the present invention, there is provided an image recording method wherein light information is recorded on an information recording medium by exposure to light information, wherein

the above-defined photoelectric sensor and an information recording medium having an information recording layer formed on an electrode are used,

the electrode of at least one of said photoelectric sensor and said information recording medium being a transparent electrode, and

said photoelectric sensor being opposed to said information recording medium on the optical axis with a gap located therebetween, or said photoelectric sensor and said information recording medium being stacked on each other with or without a dielectric interlayer located therebetween,

so that said sensor is exposed to light information and voltage is applied between both electrodes of said sensor and said recording medium to record information thereon, characterized in that:

the exposure of said sensor to image light and the application of voltage to both said electrodes are properly achieved in response to shutter speed, so that the reciprocity law can be satisfied over a wide range.

Preferably, the present invention is further characterized in that f-number or exposure time is corrected on the basis of the predetermined relation between the shutter speed and the recording properties, so that the reciprocity law can be satisfied over a wide range.

Preferably, the present invention is further characterized in that a reciprocity law failure is compensated for by starting the exposure of the above-defined

photoelectric sensor to image light prior to starting the application of voltage to both electrodes.

Preferably, the present invention is further characterized in that the period of time wherein no voltage is applied to both electrodes or the period of time wherein voltage of opposite polarity is applied to both electrodes is provided while the above-defined photoelectric sensor is being exposed to image light or after the exposure of the photoelectric sensor to image light has been finished, thereby compensating for a reciprocity law failure.

Preferably, the present invention is further characterized in that the application of voltage to both electrodes is started after an elapse of a certain time upon the exposure of the above-defined photoelectric sensor to image light finished.

Preferably, the present invention is further characterized in that the applied voltage and/or the voltage applying time are controlled, thereby compensating for a reciprocity law failure.

According to a still further aspect of the present invention, there is provided an image recording system wherein light information is recorded on an information recording medium by exposure to information light, characterized by comprising a photoelectric sensor including an electrode and an information recording medium having an information recording layer formed on an electrode,

the electrode of at least one of said photoelectric sensor and said information recording medium being a transparent electrode, and

said photoelectric sensor being opposed to said information recording medium on the optical axis with a gap located therebetween, or said photoelectric sensor and said information recording medium being stacked on each other with or without a dielectric interlayer located therebetween, and

a mechanism for starting the application of voltage between both said electrodes after said sensor has been exposed to light information or while said sensor is being exposed to light information.

According to a still further aspect of the present invention, there is provided an information recording system constructed from a one-piece type medium comprising a photoelectric sensor having a photoconductive layer stacked on a transparent electrode, an information recording medium having an information recording layer stacked on an electrode and an upper electrode, said photoelectric sensor being opposed to said information recording medium on the optical axis with a gap located therebetween, or said photoelectric sensor being stacked on said information recording medium with or without a dielectric interlayer located therebetween, wherein said photoelectric sensor is exposed to image light and voltage is applied between both said electrodes to record image or other information on said information recording medium in response to exposure quantity, characterized by further including means for measuring exposure intensity to

calculate exposure time and/or input means for exposure time, and having a function of controlling a shutter and a power source under proper conditions in response to the exposure time, thereby allowing the reciprocity law to be satisfied over a wide range of exposure time.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a current vs. time graph showing the results, as measured, of a current passing through a photoelectric sensor exposed to light at the same time as voltage is applied thereto,

Fig. 2 is a simulated voltage vs. time graph for the exposed and unexposed regions of a liquid crystal recording layer of an information recording medium made up of liquid crystals and resin for supporting them, when the information recording medium is takes as being a parallel circuit comprising a capacitor and a resistance,

Fig. 3 is a current vs. time graph showing the results of the current value measured when a photoelectric sensor is exposed to 6-lux light for 200 milliseconds at an applied voltage 200 volts,

Fig. 4 is a current vs. time graph showing a current value difference between the exposed and unexposed portions of a photoelectric sensor when it is exposed to 6-lux light,

Fig. 5 is a current vs. time graph showing a current value difference between the exposed and unexposed portions of a photoelectric sensor when it is exposed to 20-lux light,

Fig. 6 is a sectional view for illustrating a photoelectric sensor,

Fig. 7 is a sectional view illustrating an information recording system used with the method of the present invention,

Fig. 8 is a view illustrating an information recording method for recording information on the information recording system of the present invention,

Fig. 9 is graphs illustrating one example of the change in the voltage applied to a liquid crystal recording layer and a photoelectric sensor when voltage is repeatedly applied thereto,

Fig. 10 is a view illustrating a method of recording image information by multiple exposure,

Fig. 11 is a view illustrating how to measure the characteristics of the photoelectric sensor of the present invention,

Fig. 12 is a graph illustrating the electrical properties of a photoelectric sensor,

Fig. 13 is a graph showing a photo-induced current represented by a difference between light and dark currents,

Fig. 14 is a graph showing the light and dark currents measured when there is a time lag between the voltage application and exposure start points,

Fig. 15 is a graph showing the results of the photo-induced currents measured in different voltage applying and exposure modes,

Fig. 16 is a graph showing one example of the results of the photo-induced currents measured when the photoelectric

sensor is exposed to light at a constant applied voltage and at a rectangular wave form of applied voltage,

Fig. 17 is a graph showing another example of the results of the photo-induced currents measured when the photoelectric sensor is exposed to light at a constant applied voltage and at a rectangular wave form of applied voltage,

Fig. 18 is a view showing an equivalent circuit of a liquid crystal recording medium,

Fig. 19 is a view showing the ability of a photoelectric sensor to record information,

Fig. 20 is a graph illustrating one example of the results of the photo-induced current measured in the case of the application of voltage after the finish of exposure,

Fig. 21 is a graph illustrating another example of the results of the photo-induced current measured in the case of the application of voltage after the finish of exposure,

Fig. 22 is a graph illustrating still another example of the results of the photo-induced current measured in the case of the application of voltage after the finish of exposure,

Fig. 23 is a graph illustrating the results of a voltage difference between exposed and unexposed portions, as obtained by simulation,

Fig. 24 is a graph illustrating the results of the photo-induced current measured when the photoelectric sensor is exposed to light at a varying illuminance, with voltage applied to the electrodes,

Fig. 25 is a view illustrating one construction of the image recording system for changing latitude,

Fig. 26 is a view illustrating an image recording method wherein the period of time from the start of exposure to image light to the voltage application start is varied,

Fig. 27 is a graph illustrating the results measured when an image is recorded by the method of Fig. 26,

Fig. 28 is a graph illustrating the results, as measured, of the photo-induced current obtained at an extended exposure time,

Fig. 29 is a view showing a recording method wherein the photoelectric sensor is exposed to image light while voltage is being applied to the electrodes,

Fig. 30 is a view illustrating a reciprocity law failure,

Fig. 31 is a view illustrating a voltage applying and exposure method wherein the exposure of the photoelectric sensor to light is still continued while voltage is being applied to the electrodes or after the application of voltage to the electrodes has been finished,

Fig. 32 is a view illustrating a voltage applying and exposure method wherein the exposure of the photoelectric sensor to light is started prior to the application of voltage to the electrodes,

Fig. 33 is a plot showing the results, as measured, of the signals read when the photoelectric sensor is exposed to light at the same time as, and prior to, the application of voltage to the electrodes,

Fig. 34 is a view showing a recording method wherein the photoelectric sensor is exposed to image light before the application of voltage to the electrodes is started,

Fig. 35 is a plot showing the results, as measured, of the signals read when the photoelectric sensor is exposed to image light at the same time as the application of voltage to the electrodes and before the application of voltage of the electrodes is started,

Fig. 36 is a view illustrating a voltage applying and exposure method wherein the period of time from the exposure of the photoelectric sensor to image light to the start of the application of voltage is varied,

Fig. 37 is a plot showing the results, as measured, of the signals read at a high applied voltage,

Fig. 38 is a plot showing the results, as standardized, of transmittance between the unexposed and exposed portions in Fig. 37,

Fig. 39 is a view illustrating a method for synchro-flash photography,

Fig. 40 is a view illustrating a recording method wherein voltage is applied plural times to the electrodes while the photoelectric sensor is being exposed to light at an extended time,

Fig. 41 is a view showing one construction of the image recording system of the present invention,

Fig. 42 is a view showing a camera used according to the recording method of the present invention,

Fig. 43 is a view showing one example of a medium holder,

Fig. 44 is a view showing one example of the sequence of images,

Fig. 45 is a view showing another example of the sequence of images, and

Fig. 46 is a view showing still another example of the sequence of images.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The photoelectric sensor of the present invention includes a photoconductive layer stacked on an electrode. The photoconductive layer may then have a single-layer structure or a multilayer structure including a carrier generation layer and a carrier transport layer, which are stacked one upon another. The photoconductive layer generally functions such that when it is irradiated with light, photocarriers (electrons and holes) are generated in the irradiated portion, so that these carriers are movable across the width of the layer. By suitable combination of the photoconductive layer and electrode (as will be described later), semi-conductivity is imparted to the photoelectric sensor of the present invention. This enables an electric field or electric charge, which is given to an information recording medium upon the photoelectric sensor irradiated with light, to be amplified with time while it is irradiated with light. In addition, even after the irradiation of the photoelectric sensor with light has been finished, the sensor sustains the increased conductivity by a continued

application of voltage, so that a continued application of the electric field or charge to an associated information recording medium can be achieved.

The photoelectric sensor of the present invention has sustained conductivity and an amplifying action. However, photosensitive materials so far known to have sustained conductivity have electrical insulating properties in themselves; that is, they can have sustained conductivity in the process of imparting conductivity to them as by irradiating them with light. On the other hand, the photoelectric sensor of the present invention has semiconductive properties in itself. This is an essential requirement for achieving the action of the present invention; in other words, the action of the present invention would not be achieved with electrical insulating materials.

FIG. 6 is a sectional view for illustrating the photoelectric sensor.

The photoelectric sensor 10 includes a photoconductive layer 13 on an electrode 12 formed on a substrate 11. The photoconductive layer 13 is made up of a carrier generation layer 14 and a carrier transport layer 15. Upon irradiated with light, the photoconductive layer generates photocarriers such as electrons and holes in the irradiated portion, which are then movable across the width of the layer. Especially in the presence of an electric field, such effect becomes much more pronounced.

The carrier generation layer 14 comprises a binder resin and a carrier generation substance. Examples of the carrier generation substance usable in the present invention are cationic dyes, e.g., pyrylium dyes, thiapyrylium dyes, azulenium dyes, cyanine dyes, azulenium salt dyes, etc., squalium salt dyes, phthalocyanine pigments, perylene pigments, polycyclic quinone pigments, e.g., pyranthrone pigments, etc., indigo pigments, quinacridone pigments, pyrrole pigments, and azo pigments. Combinations of two or more of these dyes and pigments may be used in a single layer. Alternatively, two carrier generation layers may be provided, each layer containing a single carrier generation substance.

The carrier generation layer may further contain an electron accepting substance, examples of which are 2,4,7-trinitrofluorenone, tetrafluoro-P-benzoquinone, tetracyano-quinodimethane, triphenylmethane, maleic anhydride, and hexacyanobutadiene, all mentioned for the purpose of illustration alone.

For the binder resin, for instance, mention may be made of polyvinyl chloride resin, polyvinyl acetate resin, acrylic resin, polyester resin, polyvinyl formal resin, polyvinyl bytral resin, polystyrene resin, polycarbonate resin, polybutyl methacrylate resin, polyvinylidene chloride resin, ethyl cellulose resin, silicone resin, epoxy resin, phenol resin, melamine resin, ultraviolet curing resin, thermosetting resin, vinyl chloride-vinyl acetate copolymer resin, vinyl chloride-acrylic copolymer resin, vinyl

chloride-ethylene copolymer resin, acrylic-styrene copolymer resin, styrene-butadiene copolymer resin, and ethylene-vinyl acetate copolymer resin.

The binder resin herein used should preferably have an average molecular weight of 1,000 to 100,000, because a binder resin having a higher molecular weight is poor in the ability to be coated.

It is desired that the binder resin be mixed with the carrier generation substance in an amount of 0 to 10 parts by weight, preferably 0.3 to 1 part by weight per part by weight of the carrier generation substance. The electron accepting substance may be used at a molar ratio of 0.0001 to 10 moles per mole of the carrier generation substance. The carrier generation layer should preferably have a thickness of 0.01 to 1 μm, particularly 0.1 to 0.3 μm as measured upon drying.

The carrier transport layer 15 is made up of a carrier transport substance and a binder. The carrier transport substance is a substance well capable of transporting carriers generated in the carrier generation layer. For instance, mention may be made of oxadiazole, oxazole, triazole, thiazole, triphenylmethane, styryl, pyrazoline, hydrazone, aromatic amine, carbazole, polyvinyl carbazole, stilbene, enamine, azine, butadiene, and polycyclic aromatic compounds. In particular, the carrier transport substance must be well capable of transporting holes.

The preferable carrier transport substances are the butadiene and stilbene compounds. It is more preferable to use carrier transport materials disclosed in JP-A 62-287257,

58-182640, JP-A 48-43942, JP-B 34-5466, JP-A 58-198043, JP-A 57-101844, JP-A 59-195660, JP-A 60-69657, JP-A 64-65555, JP-A 1-164952, JP-A 64-57263, JP-A 64-68761, JP-A 1-230055, JP-A 1-142654, JP-A 1-142655, JP-A 1-155358, JP-A 1-155357, JP-A 1-161245, and JP-A 1-142643.

Referring to how to combine the carrier generation substance with the carrier transport substance, for instance, it is preferable to combine the fluorenoneazo pigment (the carrier generation substance) with the stilbene or triphenylamine compound (the carrier transport substance), or the bisazo pigment (the carrier generation substance) with the butadiene or hydrazone compound (the carrier transport substance).

When electrons are transported as the carriers in place of holes, the electron transport substance disclosed in JP-A 5-4721 may be used as the electron transport substance. For the binder resin, the same resins as mentioned in connection with the above carrier generation layer may be used. However, it is preferable to use polyvinyl chloride resin, polyvinyl acetate resin, acrylic resin, polyester resin, polyvinyl formal resin, polyvinyl bytral resin, polystyrene resin, polycarbonate resin, polybutyl methacrylate resin, polyvinylidene chloride resin, ethyl cellulose resin, silicone resin, epoxy resin, phenol resin, melamine resin, vinyl chloride-vinyl acetate copolymer resin, vinyl chloride-acrylic copolymer resin, vinyl chloride-ethylene copolymer resin, acrylic-styrene copolymer resin, styrene-butadiene copolymer resin, polyvinyl acetal resin such as ethylene-

vinyl acetate copolymer resin, and styrene resin. However, when the carrier transport substance also serves as a binder resin, it is unnecessary to use the binder resin. The binder resin used should preferably have an average molecular weight of 1,000 to 100,000, because a binder resin having a higher molecular weight is poor in the ability to be coated.

It is desired that the binder resin be used in an amount of 0.05 to 1 part by weight per part by weight of the carrier transport substance. The carrier transport layer has preferably a thickness of 1 to 50 μm, particularly 5 to 30 μm as measured upon drying.

As already mentioned in connection with the carrier generation layer, the carrier transport layer may further contain an electron accepting substance at a molar ratio of 0.0001 to 10 moles per mole of the carrier transport substance. The carrier transport layer having a thickness of 1 to 50 μm, as measured upon drying, may be formed by dissolving or dispersing the carrier transport substance, binder resin and electron accepting substance in the same solvent as mentioned in connection with the carrier generation layer, and coating the solution or dispersion on the carrier generation layer by the same coating technique, followed by drying.

In particular, the photoelectric sensor of the present invention can have an increased sensitivity by the interaction between the carrier generation and transport layers. To improve the efficiency of generating carriers, it is effective to reduce the proportion of the binder resin in

the carrier transport layer. However, the reduction in the amount of the binder resin renders it difficult to make the carrier transport layer smooth and gives rise to a change in the efficiency of generating photocarriers on the interface of the carrier generation and transport layers; that is, unless the interface is smooth, no photoelectric sensor of high performance can be achieved.

According to the present invention, it has been found that the sensitivity of a photoelectric sensor can be improved by mixing the carrier transport substance contained in the carrier transport layer with the carrier generation layer. The amount of the carrier transport substance mixed with the carrier generation layer is preferably 0.01 to 10 moles, more preferably 0.1 to 1 mole per mole of the carrier generation substance. At less than 0.01 mole the carrier transport substance has no effect upon added, whereas at higher than 10 moles there is a reduced dark current which is unsuitable for the information recording method according to the present invention.

It is here to be noted that the carrier transport substance mixed with the carrier generation layer may be identical with, or different from, the carrier transport substance used for the carrier transport layer stacked on the carrier generation layer.

The electrode 12 must be transparent if the information recording medium to be described later is opaque. When the information recording medium is transparent, however, the electrode may be either transparent or opaque. The electrode

may be formed of materials that ensure a stable surface resistivity of 50 to 104 Ω/cm^2, for instance, a thin conductive film of metals such as zinc, titanium, copper, iron and tin, a conductive film of inorganic metal oxides such as tin oxide, indium oxide, zinc oxide, titanium oxide, tungsten oxide and vanadium oxide, a conductive film of organic materials such as quaternary ammonium salts, and so on. These materials may be used alone or in composite forms of two or more. Particular preference is, however, given to oxide semiconductors, and indium-tin oxide (ITO).

The electrode 12 may be formed by suitable techniques such as evaporation, sputtering, CVD, coating, plating, dipping, and electrolytic polymerization. The film thickness of the electrode, which must be varied depending on the electrical characteristics of the electrode-forming material and the voltage applied for recording information, may be about 10 to 300 nm for an ITO film, for instance. The electrode may be formed either on the whole area between the substrate and the information recording layer or in conformity with the pattern according to which the photoconductive layer is formed.

The substrate 11 must be transparent if the information recording medium to be described later is opaque. When the information recording medium is transparent, however, the substrate may be either transparent or opaque. The substrate may have various forms such as card, film, tape or disk forms, and supports the photoelectric sensor with a certain strength. If the photoelectric sensor can be supported by

itself, it is unnecessary to use the substrate. Various materials having varying thicknesses may be used, provided that they have a certain strength enough to support the photoelectric sensor. For instance, use may be made of flexible materials such as flexible plastic films, or rigid materials such as glass sheets, plastic sheets such as polyester and polycarbonate sheets, and cards.

It is here to be noted that if the electrode 12 is transparent, a layer having an antireflection effect may optionally be stacked on the surface of the substrate that is opposite to the surface thereof on which the electrode 12 is formed. Alternatively, the transparent substrate may be regulated in terms of film thickness, so that the anti-reflection effect can be achieved. Such an antireflection layer may be used in combination with thickness regulation.

The information recording method of the present invention will now be explained. Fig. 7 is a sectional view for illustrating the information recording system used with the method of the present invention. As illustrated, the photoelectric sensor 10 is stacked on an information recording medium 20 with a spacer 16 interposed between them.

Reference will first be made to the information recording medium 20. The information recording medium according to the present invention includes an information recording layer made up of a liquid crystal-polymer composite material.

The liquid crystal-polymer composite material comprises a resin phase and a liquid crystal phase, and is of a

structure having resin particles dispersed in the liquid crystal phase. The liquid crystal material may be smectic, chloesteric or nematic liquid crystals, or their mixture. In view of memory effect, it is preferable to use smectic liquid crystals because they remain so well aligned that information can be permanently carried.

For the smectic liquid crystals, for instance, mention is made of liquid crystal materials showing a smectic A phase, e.g., cyanobiphenyl, cyanoterphenyl, phenylester and fluorine liquid crystal materials, all having a substance of liquid crystallinity with a long terminal carbon chain, liquid crystal materials showing a smectic C phase and used as ferroelectric liquid crystals, or liquid crystal materials showing smectic H, G, E, and F phases.

Nematic liquid crystals may also be used, and may be mixed with smectic or cholesteric liquid crystals so as to achieve an enhanced memory effect. For instance, use may be made of known nematic liquid crystals such as Schiff's base, azoxy, azo, phenyl benzoate, phenylcyclohexlic acid ester, biphenyl, terphenyl, phenylcyclohexane, phenylpyridine, phenyloxazine, polycyclic ethane, phenylcyclohexene, cyclohexylpyrimidine, phenyl, and tolane liquid crystals. Microcapsules of a mixture of the liquid crystal material with polyvinyl alcohol or the like., too, may be used. In view of contrast, it is preferable to select from liquid crystal materials one having large anisotropy of refractive index.

By way of example but preferably, the resin particle-forming material is an ultraviolet curing resin which is compatible with the liquid crystal material when it is in a monomer or oligomer state, or with a solvent common to the liquid crystal material when it is in a monomer or oligomer state. For such ultraviolet curing resins, for instance, mention may be made of acrylic or methacrylic esters. For such resins in a monomer or oligomer state, particular mention is made of polyfunctional monomers or polyfunctional urethanes such as dipentaerythritol hexaacrylate, trimethylolpropane triacrylate, polyethylene glycol diacrylate, polypropylene glycol diacrylate, isocyanuric acid (ethylene oxide modified) triacrylate, dipentaerythritol pentaacrylate, dipentaerythritol tetraacrylate, neopentyl glycol diacrylate and hexanediol diacrylate, and monofunctional monomers or oligomers such as nonylphenol modified acrylate, N-vinyl-2-pyrrolidone and 2-hydroxy-3-phenoxypropyl acrylate.

Any desired solvent may be used, provided that it can be commonly used with the materials used herein. For instance, hydrocarbon solvents represented by xylene, halogenated hydrocarbon solvents represented by chloroform, alcohol derivative solvents represented by methyl cellosolve, and ether solvents represented by dioxane may be used.

Examples of photo-curing agents usable to cure the ultraviolet curing resin are 2-hydroxy-2-methyl-1-phenylpropane-1-one ("Darocure 1173" manufactured by Merck & Co., Inc.), 1-hydroxycyclohexyl phenyl ketone ("Irgacure 184"

manufactured by Ciba-Geigy, Ltd.), 1-(4-isopropylphenyl)-2-hydroxy-2-methylpropane-1-one ("Darocure 1116" manufactured by Merck & Co., Inc.), benzyl dimethyl ketal ("Irgacure 651" manufactured by Ciba-Geigy, Ltd.), 2-methyl-1-[4-(methylthio) phenyl]-2-morpholinopropanone-1 ("Irgacure 907" manufactured by Ciba-Geigy, Ltd.), a mixture of 2,4-diethylthioxanthone "Kayacure DETX" manufactured by Nippon Kayaku Co., Ltd.) and p-dimethylaminoethyl benzoate ("Kayacure EPA" manufactured by Nippon Kayaku Co., Ltd.), and a mixture of isopropylthio-xanthone ("Qauntacure·ITX" manufactured by Wordblekinsop Co., Ltd.) and p-dimethylaminoethyl benzoate. However, 2-hydroxy-2-methyl-1-phenylpropane-1-one, which is liquid, is particularly preferable in view of compatibility with the liquid crystal material and polymer-forming monomer or oligomer.

It is preferable to use the liquid crystal and resin materials at such a ratio that the liquid crystal content is 10% to 90% by weight, more particularly 40% to 80% by weight. At less than 10% by weight, there is a lowering of light transmittance even when the liquid crystals of the liquid crystal phase are aligned by recording information, whereas at higher than 90% by weight, the liquid crystals bleed, so making the recorded image uneven. By allowing the information recording phase to contain a large amount of liquid crystals, the contrast ratio can be improved, and the operating voltage can be lowered as well.

The information recording layer may be formed by dissolving or dispersing the resin-forming material, liquid

crystal material, photo-curing agent and other components in a solvent to prepare a mixed solution, coating the solution on an electrode by suitable coating techniques using a blade, roll or spin coater, and curing the resin-forming material by light or heat. If required, a leveling agent may be added to the coating solution to improve its ability to be coated and the surface properties of the resulting film.

To form the information recording layer, it is required to heat the mixed solution of the resin-forming material and liquid crystal material at a temperature at which the mixed solution maintains its isotropic phase, and to completely dissolve the liquid crystal and ultraviolet-curing resin-forming material in each other, thereby obtaining an information recording layer in which the resin and liquid crystal phases are uniformly dispersed in each other. If the ultraviolet curing of the resin occurs at a temperature lower than that at which the liquid crystal shows an isotropic phase, there is then a problem that the liquid crystal phase separate largely from the resin material phase. That is, the liquid crystal domain grows too much to allow the skin layer to be completely formed on the surface of the information recording layer. This in turn causes the liquid crystal to bleed or the ultraviolet curing resin to be matted, so making it difficult for the liquid crystal recording layer to accept information accurately. In the worst case, the ultraviolet curing resin fails to retain the liquid crystal, and thereby fails to form any information recording layer. On the other hand, if heating is needed for maintaining the isotropic

phase when the solvent is evaporated, the wettability of the mixed solution with respect to the electrode in particular lowers, so failing to make the information recording layer uniform.

A fluorine type of surface active agent is preferably added to the mixed solution for the purpose of maintaining its wettability with respect to the electrode and forming a skin film on the surface of the resin. Examples of the surface active agent used herein are Fluorad FC-430 and FC-431 (manufactured by Sumitomo 3M K.K.), N-(n-propyl)-N-(β-acryloxyethyl)-perfluorooctylsulfonic acid amide (EF-125M manufactured by Mitsubishi Material Co., Ltd.), N-(n-propyl)-N-(β-methacryloxyethyl)-perfluorosulfonic acid amide (EF-135M manufactured by Mitsubishi Material Co., Ltd.), perfluoro-octanesulfonic acid (EF-101 manufactured by Mitsubishi Material Co., Ltd.), perfluorocaprylic acid (EF-201 manufactured by Mitsubishi Material Co., Ltd.), and N-(n-propyl)-N-perfluorooctanesulfonic acid amide ethanol (EF-121 manufactured by Mitsubishi Material Co., Ltd.), as well as EF-102, EF-103, EF-104, EF-105, EF-112, EF-121, EF-122A, EF-122B, EF-122C, EF-122A3, EF-123A, EF-123B, EF-132, EF-301, EF-303, EF-305, EF-306A, EF-501, EF-700, EF-201, EF-204, EF-351, EF-352, EF-801, EF-802, EF-125DS, EF-1200, EF-L102, EF-L155, EF-L174 and EF-L215, all manufactured by Mitsubishi Material Co., Ltd. Additional mention is made of 3-(2-perfluorohexyl)ethoxy-1,2-dihydroxypropane (ME-100 manufactured by Mitsubishi Material Co., Ltd.), N-n-propyl-N-2,3-dihydroxypropylperfluorooctylsulfonamide (MF-110 manufactured

by Mitsubishi Material Co., Ltd.), 3-(2-perfluorohexyl) ethoxy-1,2-epoxypropane (MF-120 manufactured by Mitsubishi Material Co., Ltd.), N-n-propyl-N-2,3-epoxypropylperfluoro-octylsulfonamide (MF-130 manufactured by Mitsubishi Material Co., Ltd.), perfluorohexylethylene (MF-140 manufactured by Mitsubishi Material Co., Ltd.), N-[3-trimethoxysilyl)propyl] perfluoroheptylcarboxylic acid amide (MF-150 manufactured by Mitsubishi Material Co., Ltd.), N-(3-trimethoxysilyl)propyl) perfluoroheptylsulfonamide (MF-160 manufactured by Mitsubishi Material Co., Ltd.), etc. The fluorine type of surface active agent is used in an amount of 0.1% by weight to 20% by weight with respect to the total amount of the liquid crystal and resin-forming materials.

The coating solution used to form the information recording layer has preferably a solute content of 10% by weight to 60% by weight. By properly determining curing conditions, i.e., the type and concentration of resin, the layer coating temperature and the ultraviolet curing condition, it is possible to form a good-enough skin layer consisting only of a resin layer free from any liquid crystal phase as an outer surface layer. It is thus not only possible to increase the proportion of the liquid crystal material used in the information recording layer but also possible to prevent the bleeding of the liquid crystals.

Although the ultraviolet curing resin materials have been described as resin materials, it is also possible to use thermosetting resin materials which are compatible with a solvent common to the liquid crystal material, for instance,

acrylic resin, methacrylic resin, polyester resin, polystyrene resin, copolymers composed mainly of these resins, epoxy resin, silicone resin, etc.

The thickness of the information recording layer, because of having an influence on definition, is preferably in the range of 0.1 μm to 10 μm, especially 3 μm to 8 μm as measured upon dried. Within this thickness range, the information recording layer can be operated at a low voltage yet with high definition. At too small a thickness the contrast of the information recording portion becomes low, whereas at too large a thickness the operating voltage becomes high.

When the information recording layer can be supported by itself, the substrate can be omitted; that is, an ITO or other film can be stacked on the recording layer as by evaporation or sputtering with neither cracking nor a conductivity drop, because the skin layer has been formed on the surface of the recording layer. In this case, it is preferable that the information recording medium is fabricated by providing an electrode on the information recording layer located on a provisional substrate and then removing the provisional substrate from the information recording layer.

An electrode 22 is stacked on a substrate 21 of the information recording medium, and an information recording layer 23 is formed on the electrode. The electrode 22 is formed of the same material as the electrode 12 of the photoelectric sensor already mentioned, and is formed on the

substrate 21 in the same stacking manner as already mentioned.

This information recording medium is opposed to the above photoelectric sensor, with a spacer 16 interposed between them, as shown in Fig. 7, and both electrodes 12 and 22 are connected to each other through a voltage source V, thereby constructing a first information recording system. In this system, at least one of the electrodes 12 and 22 may be transparent.

The spacer is preferably formed using a resin film such as that of polyester such as polyethylene terephthalate, polyimide, polyethylene, polyvinyl chloride, polyvinylidene chloride, polyacrylonitrile, polyamide, polypropylene, cellulose acetate, ethyl cellulose, polycarbonate, polystyrene or polytetrafluoroethylene. It may also be formed by the coating and drying of a solution containing one of the above resins. Alternatively, the spacer may be formed by the evaporation of a metal material such as aluminum, selenium, tellurium, gold or platinum, or an inorganic or organic compound. Spacer thickness defines an air gap distance between the photoelectric sensor and the information recording medium and has an influence on the distribution of the voltage applied to the information recording layer, and so is preferably up to 100 μm, more preferably 3 μm to 30 μm.

As mentioned above, the information recording system of the present invention may be constructed by arranging the photoelectric sensor and information recording medium with a gap located between them. Alternatively, it may be

constructed by stacking the photoelectric sensor directly on the information recording medium. Still alternatively, it may be of a one-piece type constructed by forming an insulating dielectric layer on the photoconductive layer of the photoelectric sensor and then forming the information recording layer and upper electrode thereon.

The dielectric layer is preferably formed by stacking an inorganic material such as SiO_2, TiO_2, CeO_2, Al_2O_3, GeO_2, Si_3N_4, AlN or TiN on the photoconductive layer by suitable techniques such as evaporation, sputtering or chemical vapor deposition (CVD), or alternatively stacking on the photoconductive layer an aqueous solution of a water-soluble resin less compatible with an organic solvent, e.g., polyvinyl alcohol, aqueous polyurethane or water glass by suitable coating techniques such as spin coating, blade coating or roll coating. Additionally, use may be made of a fluorocarbon resin that can be coated on the photoconductive layer. In this case, a solution of the fluorocarbon resin in a fluorine type solvent may be coated on the photoconductive layer by spin coating or stacked on the photoconductive layer as by blade or roll coating.

For the fluorocarbon resin that can be coated on the photoconductive layer, it is preferable to use a fluorocarbon resin disclosed in JP-A 1-131215 or an organic material capable of forming a film in a vacuum system, e.g., poly-para-xylene.

The method of recording information on the information recording system according to the present invention will now

be explained with reference to an arrangement wherein the photoelectric sensor and information recording medium are arranged with a gap located between them. Fig. 8 is a view that illustrates the method of recording information using the photoelectric sensor of the present invention.

As illustrated, the information recording system includes a controller 18 designed to control the application of voltage such that voltage is applied between the electrodes 12 and 22 upon exposure of the photoelectric sensor to information light 17, voltage is intermittently fed to the electrodes 12 and 22 during exposure of the photoelectric sensor to information light 17, or voltage is again applied to the electrodes 12 and 22 upon the finish of application of voltage. Photocarrier generated in the portion of the photoconductive layer (consisting of the carrier generation and transport layers 14 and 15) on which the light is incident are moved by an electric field created by both the electrodes, so that the redistribution of the voltage can occur. This in turn causes the liquid crystals in the liquid crystal phase of the information recording layer to be so aligned that information can be recorded on the information recording layer according to the pattern of information light 17. It is here to be understood that while the information light 17 is incident on the photoelectric sensor, voltage may be applied to the electrodes for a given time.

The operation voltage and its range vary with liquid crystals. Thus, when the voltage to be applied and the

voltage applying time are to be predetermined, it is preferable to make proper determination of the voltage distribution in the information recording medium so that the voltage distributed to the information recording layer can be set within the operating voltage range of the liquid crystal used. This recording method makes planar analog recording and liquid crystal level recording possible, and enables information to be recorded with high resolution. The exposure pattern is retained in the form of a visible image by the alignment of the liquid crystals in the liquid crystal phase.

A camera or laser may be used for recording information. When the camera is used, an information recording medium is used in place of photographic film used with an ordinary camera. In this case, either an optical shutter or an electrical shutter may be used. For color photography, light information is separated through a combined prism and color filter into R, G and B light components in the form of parallel beams, which are in turn recorded on three R, G and B information recording media to form one frame. Alternatively, the R, G and B images may be recorded on three different regions of one information recording medium to form one frame.

For the laser recording mode, argon laser (514.488 nm), helium-neon laser (633 nm) and semiconductor laser (780 nm, 810 nm, etc.) may be used as light sources. Exposure of the photoelectric sensor to laser is achieved by scanning, corresponding to image, character, code or line drawing

signals. Image or other analog recording is achieved by modulating the intensity of laser light, while digital recording, like character, code or line drawing recording, is achieved by on/off control of laser light. An image comprising an array of halftone dots is formed by placing laser light under on/off control using a dot generator.

Upon removal of the information recording medium, the light information recorded thereon is reproduced by transmitted light. At the information-recorded portion the liquid crystals are so aligned in the direction of the electric field that light can be transmitted through it, whereas at the portion with no information recorded light is scattered, so that both portions can be in good contrast with each other. The information recorded on the recording information system may also be read by reflected light.

The information recorded by the alignment of the liquid crystals is visibly readable information, which may be magnified through a projector. If laser scanning or a CCD is used, this information may then be read by transmitted or reflected light with high precision. If required, light scattering may be avoided by use of schlieren optics.

The information recording medium of the information recording system according to the present invention is designed to record electrostatic information by liquid crystal alignment in a visible form. By selection of a suitable combination of liquid crystals with resin, the information once made visible by liquid crystal alignment is not made to vanish or remain memorized. Upon heated to a

high temperature in the vicinity of the isotropic phase transition temperature, the thus memorized information can vanish, so that the information recording layer can be again used for recording information.

The photoelectric sensor of the present invention is well fit for recording information on an information recording system including an information recording layer formed of a liquid crystal-polymer composite material, as mentioned above, but may be applied to other information recording media as well. These information recording media, for instance, may be an electrostatic information recording medium including an information recording layer formed of an insulating layer of resin excellent in charge retainability such as fluorocarbon resin, wherein information is stored in the form of electrostatic charges and electrostatic information is reproduced by toner development or potential reading, as typically set forth in JP-A 4-70842, JP-A 4-46347, JP-A 3-7942 and JP-A 4-73769, and an information recording medium including an information recording layer formed of a thermoplastic resin layer wherein, as mentioned just above, information is stored on the surface in the form of electrostatic charges so that it can be stored by heating in the form of a frost image, and the thus stored information is reproduced in the form of a visible image, as typically disclosed in JP-A 3-170985, JP-A 3-170984 and JP-A 3-192288.

In its as-made state, the photoelectric sensor according to the present invention cannot be used for the recording method according to the present invention, because it has no

semi-conductivity in that state. To allow the photoelectric sensor to be used according to the present invention, it must be allowed to stand alone for a given time or longer. This then enables the photoelectric sensor to show semi-conductivity even in a dark place. Prior to use, the whole surface of the photoelectric sensor may otherwise be uniformly exposed to a sufficient quantity of light.

With the photoelectric sensor of the present invention, it is possible to record information with good-enough contrast by varying the voltage application and exposure start points, even when it is exposed to light of low intensity. It is also possible to record information at the optimum applied voltage within the optimum voltage applying time, because the time at which the potential applied to the liquid crystal recording layer reaches a maximum varies depending on the voltage application and exposure start points.

In the photoelectric sensor of the present invention, there is a conductivity difference between the exposed and unexposed portions depending upon voltage applying modes, one mode wherein after voltage is applied to the sensor upon, or at the same time, exposure of the sensor to light, the application of voltage to the sensor is interrupted and then resumed, and another mode wherein after voltage is applied to the sensor upon, or at the same time, exposure of the sensor to light, the application of voltage of opposite polarity is followed by the application of voltage. On the other hand, when the photoelectric sensor is exposed to light to resume

the application of voltage while the application of voltage is interrupted or the voltage of opposite polarity is applied to the sensor, the conductivity of the exposed portion is increased, as in the case where the application of voltage is continued.

By repeating the application of voltage it is also possible to record image information with high-enough contrast. By the first application of voltage with exposure of the sensor to light, the voltage of the unexposed portion of the liquid crystal recording layer has the threshold value, so that the voltage of the liquid crystal recording layer can be lowered either by interrupting the application of voltage just after the liquid crystal alignment starts, or the application of a voltage lower than the first applied voltage or a voltage of opposite polarity. After an elapse of some time in this state, voltage is again applied to the sensor and the application of the voltage is continued until the voltage of the unexposed portion has the threshold value. In the state where the application of voltage is interrupted or the voltage of opposite polarity is applied to the sensor, the voltage of opposite polarity is often applied to the sensor. By resuming the application of voltage, however, much more voltage can be applied to the exposed portion of the liquid crystal recording layer to enable information to be recorded thereon, because there is a conductivity difference between the unexposed and exposed portions.

An example of the change of the voltage applied to the liquid crystal recording layer and photoelectric sensor by

the repeated application of voltage is shown in Fig. 9 with reference to an information recording system wherein the photoelectric sensor is opposed to the information recording medium with an air gap located between them. However, it is to be understood that even with an information recording system wherein the photoelectric sensor and liquid crystal recording medium are stacked one upon another with or without a dielectric interlayer located between them, it is possible to record information by the same voltage applying method as mentioned above.

An account will now be given of how to record at least two items of image information by multiple exposure, using the photoelectric sensor. Fig. 10 illustrates how to record two items of image information. The photoelectric sensor is exposed to one image light for a time t1 prior to applying voltage thereto, and voltage is applied to the photoelectric sensor for a time t3 simultaneously with exposure of the sensor to another image light for a time t2. In this way, at least two items of information such as a picture and characters can be superposed one upon another in the form of one image. Thus, at least two items of image information may be recorded on the same position of the liquid crystal recording medium while they are superposed one upon another, or they may be recorded on discrete positions of the liquid crystal recording medium.

By recording plural items of image information in a single voltage applying operation, the second image information can be recorded without putting the first

recorded image information out of order. Although no limitation is placed on the number of image information to be superposed one upon another, it is required that image recording be made within a relatively short period of time, because the first recorded image information often vanishes when the time interval between the first and second recording step is too long.

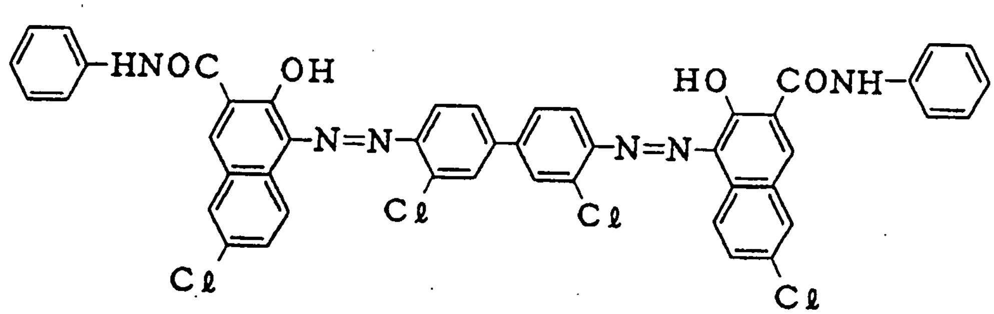
Since image information decays with time, it is required to regulate or control exposure time, etc., so as to record each image information at equal intensity.

To record information such as an image or characters by means of laser, the photoelectric sensor is scanned with laser light. By scanning the photoelectric sensor with laser light while it is opposed to the liquid crystal recording medium, it is possible to write image or character information on the photoelectric sensor. After writing has been finished, voltage is applied between the two electrodes of the photoelectric sensor and liquid crystal recording medium, so that the image can be recorded on the liquid crystal recording layer. When laser light is used, it is prima facie possible to thermally write information on the liquid crystal recording medium, but a problem with thermal writing is that no image of high resolution can be written on the liquid crystal recording medium due to heat diffusion. However, if information is written on the photoelectric sensor and recorded on the liquid crystal recording medium with the application of voltage, it is then possible to achieve a recorded image of high resolution.

Example 1

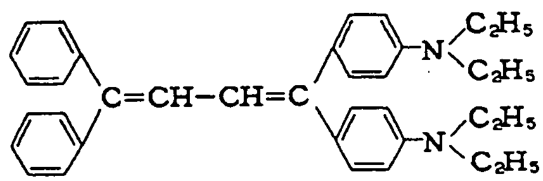
An ITO film of 100 nm in thickness was sputtered on a well washed glass substrate of 1.1 mm in thickness to obtain an electrode layer.

Then, 3 parts by weight of a bisazo pigment of the structure given below, 0.75 parts by weight of a vinyl chloride-vinyl acetate copolymer, 0.25 parts by weight of polyvinyl acetate, 98 parts by weight of 1,4-dioxane and 98 parts by weight of cyclohexanone were mixed together and dispersed in each other in a paint shaker for 6 hours to prepare a coating solution. The coating solution was spin-coated on the above electrode layer at 1,400 rpm for 0.4 seconds, and then dried at 100°C for 1 hour to obtain a carrier generation layer of 300 nm in thickness.



A coating solution obtained by mixing together 1 part by weight of a carrier transport substance or a compound of the following structure, 4 parts by weight of polystyrene resin, 22 parts by weight of 1,1,2-trichloromethane and 14 parts by weight of dichloromethane was spin-coated on the above carrier generation layer at 400 rpm for 0.4 seconds, and dried at 80°C for 2 hours to obtain a carrier transport

layer. In this way, there was obtained a photoelectric sensor including a 20-μm thick photoconductive layer consisting of the carrier generation and transport layers. The thus fabricated photoelectric sensor was used after aged at a relative humidity of 60% or less in a dark place for 3 days.



How to measure the characteristics of the photoelectric sensor according to the present invention is illustrated in FIG. 11. The photoelectric sensor 10 includes a transparent electrode 12 on a substrate 11. The transparent electrode includes thereon a photoconductive layer 13 consisting of carrier generation and transport layers, and the photoconductive layer includes thereon a gold electrode 31 over an area of 0.16 cm^2. Green light from a light source 32 through a filter 33 is directed to the photoelectric sensor 10 through a shutter 35 the clicking of which are controlled by a pulse generator 34. The pulse generator also controls the voltage and voltage applying time of a power source 36, which applies direct current between the gold electrode 31 and the transparent electrode 12 such that the transparent electrode is of positive polarity. A voltage across a resistance connected to the gold electrode was used to measure a photoinduced current on an oscilloscope 37.

At the same time as the start of a 33-millisecond exposure at an exposure intensity of 20 luxes, a voltage of 200 volts is applied to the photoelectric sensor. The resulting current L1 (light current) passing through the photoelectric sensor is shown in Fig. 12 together with a current L2 passing through the photoelectric sensor when it is exposed to no light, and a photo-induced current represented by a difference between the light and dark currents is shown in Fig. 13. The photo-induced current continues to increase during exposure, and decays gently at the applied voltage even after the exposure has been finished; in other words, this current continues to flow over a sufficient period of time.

Referring now to Fig. 14, there are shown the light and dark current data obtained when there is a time lag between the voltage application start point and the exposure start point. As in the case of Fig. 12, the exposure time and intensity were 20 luxes and 33 msec., but a voltage of 200 volts was applied to the photoelectric sensor at the same time as the exposure thereof to light was finished. Fig. 14 reveals that when the exposure of the photoelectric sensor to light is finished before the voltage is applied thereto, there is a conductivity difference between the exposed and unexposed portions.

The photo-induced current data obtained when the photoelectric sensor is exposed to light at an applied voltage according to the above-described two methods are shown in Fig. 15. In both methods the photoelectric sensor

was exposed to 20-lux light for 33 msec., but in one method (A) a voltage of 200 volts was applied thereto at the same time as the start of exposure, while in another method (B) a voltage of 200 volts was applied thereto at the same time as the finish of exposure. The photo-induced current represented by the difference between the light and dark currents is independent on the exposure and voltage application start points; that is, it is dependent on the exposure time, and so has a substantially equal value at the applied voltage. It is thus unnecessary to apply voltage to the photoelectric sensor at the same time as the start of exposure or just after the finish of exposure. In other words, even when voltage is applied to the photoelectric sensor during exposure or after an elapse of some time from the finish of exposure, similar results are obtainable.

In this example, the photo-induced current is described as having an almost equal value, but the photo-induced current is not always required to have an equal value; in some cases, the photo-induced current varies depending on the exposure and voltage application start points. Even in such cases, the photoelectric sensor in which the exposed portion becomes higher in conductivity than the unexposed portion when voltage is applied thereto after the finish of exposure can be used with the information recording method of the present invention.

Example 2

The characteristics of the photoelectric sensor were measured following Example 1 with the exception that voltage was applied thereto as follows.

The photoelectric sensor was exposed to 20-lux light for 33 milliseconds at a constant applied voltage of 200 volts, and at a rectangular wave form of applied voltage of 200 volts. The resulting current data are shown in Fig. 16. The application of the rectangular wave to the sensor was carried out every 50 msec.

The currents obtained at the constant applied voltage are shown by broken lines, and the currents obtained at the rectangular wave form of applied voltage by solid lines.

At no applied voltage no current flows. Either at the constant applied voltage of 200 volts or at the rectangular wave or pulse form of applied voltage of 200 volts, however, the currents have an almost equal value. Even in the cycle in which the finish of the application of voltage is followed by resuming the application of voltage, the obtained currents have substantially the same value as in the case where the application of 200 volts is continued.

In the above example, the voltage is described as being zero while the pulse form of voltage is applied to the photoelectric sensor. Even when voltage of opposite polarity is applied to the sensor while the pulse form of voltage is applied thereto, however, the current has a value equal to that obtained when a constant voltage is applied thereto, if the voltage of 200 volts is applied thereto as mentioned above. Where the voltage of opposite polarity is applied to

the sensor, a current of opposite polarity flows therethrough. In this case, there is no conductivity difference between the exposed and unexposed portions.

As mentioned above, the photoelectric sensor, when designed such that either when a constant voltage is applied thereto or when a pulse form of voltage is applied thereto, the current measured has an almost equal value, can be used with the information recording method according to the present invention. The photoelectric sensor, even when designed such that whether during exposure or after the finish of exposure, the exposed portion is different from, and higher than, the unexposed portion in terms of conductivity, may also be used with the information recording method of the present invention.

Example 3

The photoelectric sensor was exposed to 12-lux light for an exposure time of 500 msec. In Fig. 17, the current obtained when a constant voltage of 200 volts was continuously applied thereto as in Example 2 is shown by a broken line, and the current obtained when the application of a rectangular wave form of voltage thereto was continued for 50 msec., and then interrupted for 50 milliseconds by a solid line. As in Examples 1 and 2, the photo-induced current continues to increase during exposure in the state where a constant voltage is applied to the sensor. When the rectangular wave voltage in a pulse form is applied to the sensor, however, the photo-induced current is found to

increase during exposure even at an applied voltage of 0 volt.

Example 4

The photoelectric sensor was used with a liquid crystal recording medium functioning as the information recording medium. The ability of the sensor to record information in this case was measured. As shown in Fig. 18, the liquid crystal recording medium may be expressed as a parallel circuit consisting of a resistance (R_{LC}) and a capacitor (C_{LC}), and the optical sensor may be expressed as a parallel circuit consisting of a resistance (R_{PS}) and a capacitor (C_{PS}) as well. The photoelectric sensor had a thickness of 10 μm, the liquid crystal recording medium had a capacity of 1,000 pF/cm^2 and an electrical resistance of 120 MΩ, and the spacing between the photoelectric sensor and liquid crystal recording medium was 10 μm. The photoelectric sensor was exposed to 20-lux light for 1/30 seconds while 730 volts were applied between the electrode of the sensor and the electrode of the liquid crystal recording medium. The results found from the obtained data are shown in Fig. 19.

Just after the application of voltage, the voltage is distributed according to the capacity ratio of the photoelectric sensor and liquid crystal recording medium. Thereafter, this voltage distribution varies due to the resistance components of the photoelectric sensor and liquid crystal recording medium, resulting in an increase in the voltage of the liquid crystal recording medium. Because the photoelectric sensor varies in conductivity between the

exposed and unexposed portions, much more voltage is applied to the liquid crystal recording medium at the exposed portion than at the unexposed portion.

At higher than the threshold voltage, the liquid crystal recording medium increases in transmittance because the liquid crystals are excessively aligned in the direction of the electric field. Consequently, the voltage of the liquid crystal recording medium reaches the threshold voltage more earlier at the exposed portion than at the unexposed portion. Thus, when the application of voltage is interrupted upon the voltage of the unexposed portion reaching the threshold value at which the liquid crystals start to align, the exposed portion to which a voltage higher than the threshold value has been applied so that the liquid crystals have been aligned differs from the unexposed portion in terms of transmittance, and this state is maintained even after the finish of the application of voltage so that information can be recorded thereon.

Example 5

The photo-induced current represented by the difference between the light and dark currents was measured following Example 2 with the exception that the photoelectric sensor was exposed to 6-lux light for 200 msec., and a voltage of 200 volts was then applied thereto simultaneously with the finish of exposure. The results are shown in Fig. 20, in which the hatched region shows the photo-induced current for 50 milliseconds after the start of the application of voltage

effective for recording information on the liquid crystal recording medium.

Example 6

The photo-induced current represented by the difference between the light and dark currents was measured following Example 5 with the exception that the photoelectric sensor was exposed to 6-lux light for 200 msec., and a voltage of 200 volts was then applied thereto 150 milliseconds after the start of exposure. The results are shown in Fig. 21, in which the hatched region shows the photo-induced current for 50 milliseconds after the start of the application of voltage effective for recording information on the liquid crystal recording medium.

Comparative Example 1

The photo-induced current represented by the difference between the light and dark currents was measured following Example 5 with the exception that the photoelectric sensor was exposed to 6-lux light for 200 msec., and a voltage of 200 volts was then applied thereto at the same time as exposure. The results are shown in Fig. 22, in which the hatched region shows the photo-induced current for 50 milliseconds after the start of the application of voltage effective for recording information on the liquid crystal recording medium.

By exposure for an extended time it is possible to obtain a photo-induced current equivalent to that obtained by exposure at a light intensity of 20 luxes for 33 msec. However, the area of the hatched region showing the photo-

induced current for 50 milliseconds after the start of the application of voltage is smaller than that of Example 5 or 6 wherein the photoelectric sensor is exposed to 20-lux light, and this indicates that no image of good-enough contrast can be recorded on the recording medium.

Example 7

As in Example 4, the voltage applied to the liquid crystal recording medium was calculated, and the voltage difference between the exposed and unexposed portions was simulated. The results are shown in Fig. 23, wherein a represents the case where the photoelectric sensor was exposed to 20-lux light for 33 msec., and voltage was applied to the electrodes at the same time as the exposure, b Comparative Example 1, c Example 5, d Example 6, and e the case where the photoelectric sensor was exposed to 6-lux light for 200 msec., and voltage was applied to the electrodes 175 milliseconds after the start of exposure.

Given that the threshold voltage of the liquid crystal recording medium is 200 volts, the voltage of the liquid crystal recording medium at the unexposed portion reaches the threshold voltage in about 65 msec. By interrupting the application of voltage within this time, it is therefore possible to record information. By comparing the potential differences of the light and dark portions in this case, it is possible to make estimation of the contrast after information has been recorded on the recording medium. From Fig. 23, it is found that no striking contrast is obtained in the case of b, because the potential difference of b is about

half of that of a after an elapse of 65 msec. However, the potential differences obtained in c, d and e are almost equal to or higher than that obtained in a. The cases d and e show a virtually equal potential difference after an elapse of 65 msec. By making the applied voltage in e higher than that in d and recording information for a voltage applying time of about 30 msec, however, it is possible to record information with a more striking contrast.

Reference will now be made to the recording method of the present invention wherein the time from the start of exposure of the photoelectric sensor to image light to the start of application of voltage to the electrodes is varied, thereby changing the latitude of the recorded image.

The photoelectric sensor of the present invention was exposed to image light at a varying exposure intensity while voltage was applied to the electrodes. The resulting photo-induced currents are shown in Fig. 24. The exposure time was likewise 33 msec. The exposure intensity was Δ = 400 luxes, + = 200 luxes, X = 120 luxes, ▯ = 80 luxes, O = 40 luxes, and · = 20 luxes.

The photo-induced current continues to increase during exposure, and reaches a maximum after an elapse of 33 msec. At this time the photo-induced current is dependent on light intensity; the higher the light intensity, the larger the photo-induced current. Upon exposure, the photo-induced current decays, but the higher the exposure intensity, the higher the decay rate, and the lower the exposure intensity, the lower the decay rate. The proportion of the photo-

induced current at a low exposure intensity to the photo-induced current at a high exposure intensity is lower after an elapse of a certain time upon exposure than just after the finish of exposure.

In the image recording method of the present invention, the liquid crystals are aligned depending on the magnitude of such a photo-induced current. From the results shown in Fig. 24, it is expected that when voltage is applied to the electrodes after an elapse of some time upon the finish of exposure of the photoelectric sensor to image light, it is possible to reduce a difference in the alignment of liquid crystals between portions exposed to light at low and high exposure intensities. In other words, it is expected that the latitude of exposure can be made wide.

Fig. 25 illustrates one construction of the image recording system for varying exposure latitude. In this image recording system, the photoelectric sensor 10 of the present invention is opposed to the liquid crystal recording medium 20 of the present invention with a gap located between them, using as the spacer a polyimide film of about 9 μm in thickness. The image recording system enables the photoelectric sensor 10 to be exposed to the transmitted image of a color transparency 54, using a power source 51, a lens 53 and a shutter 52. By use of a control circuit 40 of the image recording system, it is possible to control the power source 30 and shutter 52 and thereby expose the sensor to the image at any desired time. By use of the light source 30, it is possible to apply voltage between the two

electrodes at any desired time. It is also possible to optionally vary the timings of applying voltage to the electrodes and exposing the sensor to the image.

Used for the color transparency was a gray scale with the optical density changing by an increment of 0.1 for each step. An account will now be given of the timings of applying voltage to the electrodes and exposing the sensor to the image according to this example with reference to Fig. 26. Here let t_{ex} and t_d represent the time of exposure of the sensor to the image and the period of time from the start of exposure of the sensor to the image to the start of application of voltage to the electrodes, respectively. The image was recorded at a varying time t_d of 0 to 125 milliseconds under otherwise identical conditions. The recording conditions at this time were the exposure time = 1/125 seconds, the applied voltage = 750 volts, and the voltage applying time = 50 msec.

Under these conditions the image was recorded. The liquid crystal recording medium 20 with the image recorded thereon was irradiated with reading light to read the transmitted light by a CCD sensor. Fig. 27 is an exposure quantity (gray scale step) vs. read signal plot. In Fig. 27, O is $t_d = 0$, X is $t_d = 12$ msec., Δ is $t_d = 28$ msec., ▯ is $t_d = 50$ msec., and is $t_d = 125$ msec.

From Fig. 27, it is seen that when voltage is applied to the electrodes at the same time as the exposure of the sensor to the image (O), the step transmission density is saturated at about 0.8, resulting in an image of narrow latitude, but

as the period of time from the exposure of the sensor to the image to the application of voltage to the electrodes increases, the saturation density increases, so enabling latitude to be made wide.

By delaying the start timing of application of voltage to the electrodes it is possible to record images under wide latitude conditions. The time t_d may be determined depending on the state of the subject to be recorded, and the purpose as well.

Reference will now be made to compensate for a reciprocity law failure in recording images using the image recording system according to the present invention.

As already explained with reference to Figs. 1 and 3, the current value of the photoelectric sensor increases simultaneously with the start of exposure of the sensor to light, and decays slowly even after the exposure has been finished; it does not immediately return back to the original state. The current of the photoelectric sensor is not zero even where it is not exposed to light, and is herein called the base current. The photo-induced current is then defined as being a difference between the base current and an actually induced current. By making use of this difference it is possible to record images. Here it should be understood that the photo-induced current has the nature of depending on the base current, and the larger the base current (the higher the conductivity of the photoelectric sensor), the larger the photo-induced current, and the

smaller the base current (the lower the conductivity of the photoelectric sensor), the smaller the photo-induced current.

Thus, the system of the present invention makes use of the phenomenon that the photo-induced current continues to flow, albeit decaying slowly, even after the exposure of the sensor to light has been finished. Therefore, the photo-induced current can be effectively used for achieving an improvement in recording sensitivity by allowing the application of voltage to the electrodes to be continued for some time after the finish of the exposure.

As already explained with reference to Fig. 15, it is found that either when the photoelectric sensor is exposed to the image light with voltage applied to the electrodes (A) or when voltage is applied to the electrodes after the exposure of the sensor to the image light has been finished (B), the photo-induced current likewise flows after the start of application of voltage to the electrodes. This appears to be due to a precursor that would have been formed by exposure in the photoelectric sensor by exposure, even with no voltage applied to the electrodes. This precursor is then believed to make the current flow easily through the photoelectric sensor (or lower the resistance value).

The results of the photo-induced current measured at a extremely long exposure time (1 second) are shown in Fig. 28. As can be seen, the photo-induced current increases linearly just after the start of exposure of the sensor to light. After an elapse of about 1 second, however, the photo-induced current reaches a substantial saturation value upon the

photo-induced current increase dropping sharply in the vicinity of 200 msec. The tendency shown in Fig. 28 also holds for the precursor.

An account will now be given of how the reciprocity law and reciprocity law failure are measured.

The reciprocity law and reciprocity law failure were measured using the optical system and image exposure system shown in Fig. 25. In this case, the intensity of light incident on the photoelectric sensor was regulated by transmitting light from the light source 40 through an ND filter (not shown) and changing the transmittance of the transmitted light.

The photoelectric sensor was opposed to the liquid crystal medium with an air gap located therebetween, using a film spacer of about 10 μm in thickness. To record an image on the recording medium, the photoelectric sensor was exposed to image light and a voltage of 700 volts was applied from the power source 30 between the electrodes of the sensor and medium for 60 msec. The power source 30 is controlled by the controller 40 so that voltage can be applied to the electrodes at any desired timing in response to the exposure of the sensor to image light.

The reciprocity law failure was measured by changing the exposure intensity and time using such an image exposure system and determining the gradation characteristics, i.e., the relation between exposure quantity and the transmittance of the liquid crystal medium. It is here to be noted that this measurement was done under the same voltage applying

conditions, because a change in the voltage applying conditions causes a change in the gradation characteristics.

First, the reciprocity law and reciprocity law failure were examined under ordinary image exposure and voltage applying conditions. In an image recording method carried out under ordinary voltage applying conditions, the exposure of the sensor to image light is started at the same time as the application of voltage to the electrodes, and the application of voltage is continued even after the exposure of the sensor to image light has been finished, as illustrated in Fig. 29.

Image recording was done for a voltage applying time of 60 msec., while the exposure intensity was regulated so that the same exposure quantity was obtained at exposure times of 1/400, 1/125, 1/60, 1/30 and 1/15 seconds. The results of the images measured by a specially designed scanner are shown in Fig. 30 with exposure quantity change as abscissa and read signal strength as ordinate. It is here to be noted that only the results obtained at 1/400 seconds (O), 1/125 seconds (□) and 1/30 seconds (+) are shown in Fig. 30. In Fig. 30, it is also to be noted that the exposure times of 1/4 seconds (x) and 2.0 seconds (Δ) imply that the sensor was exposed to light at the same voltage applying time but prior to the start of application of voltage to the electrodes, as explained later with reference to Fig. 32.

Within the range of 1/125 to 1/30 seconds, the gradation characteristic curves overlap each other, indicating that the reciprocity law is satisfied. In 1/400 seconds the

characteristic curve is slightly shifted to the low intensity side.

When the exposure time is shorter than the voltage applying time, it is possible to make effective use of the photo-induced current by allowing the application of voltage to the electrodes to be continued even after the exposure of the sensor to light. In 1/15 seconds, however, the voltage applying and exposure method shown in Fig. 31(a) wherein the exposure time is nearly equal to the voltage applying time must be used. Thus, the reciprocity law fails (a reciprocity law failure), because it is impossible to make effective use of the photo-induced current and so the characteristic curve is shifted to the high intensity side.

When the photoelectric sensor is exposed to light for a time longer than 1/15 seconds, i.e., when the voltage applying and exposure method shown in Fig. 31(b) is used, the step of exposing the sensor to light after the finish of application of voltage becomes entirely useless. In this region, the reciprocity law thus fails, because the longer the exposure time, the more likely is the characteristic curve to be shifted to the high intensity side.

Explanation will now be offered as to how to compensate for the reciprocity law failure.

<u>Method for compensating for the reciprocity law failure in a region where exposure time is long</u>

A first account will be given of the method for compensating for the reciprocity law failure in a region where exposure time is long.

As already explained, the photoelectric sensor used with the system of the present invention has the property of, even when it is exposed to image light with no voltage applied to the electrodes, generating the photo-induced current by applying voltage to the electrode later. It is this property that is used for exposing the sensor to light for an extended period of time. As illustrated in Fig. 32 as an example, the exposure of the sensor to image light is started prior to the application of voltage to the electrodes. Then, the exposure of the sensor to image light is finished prior to or at the same time as the finish of the application of voltages to the electrode, whereby any useless consumption of light can be avoided prior to the start of the application of voltage to the electrodes.

The photoelectric sensor was exposed to image light at the same time as the application of voltage to the electrodes as shown in Fig. 31, and the photoelectric sensor was exposed to image light prior to the application of voltage to the electrodes, and the application of voltage and exposure were finished at the same time, as shown in Fig. 32. The results of a comparison of the signals read out of the images recorded in both cases are shown in Fig. 33. In either case, the exposure time was 2 seconds and a voltage of 700 volts was applied to the electrodes for 65 msec. In Fig. 33, O are data obtained by the voltage applying and exposure method shown in Fig. 32, and X are data obtained by the voltage applying and exposure method shown in Fig. 31(b). It is here to be noted that he characteristics of O are identical with

those of Δ in Fig. 30. As can be seen from this figure, when the sensor is exposed to light at the same time as the application of voltage to the electrodes, the characteristic curve is largely shifted to the high intensity side, because the light after the finish of the application of voltage becomes entirely useless. It is also seen that by starting the exposure of the sensor to image light prior to the application of voltage to the electrodes, it is possible to avoid any shift of the characteristic curve to the high intensity side even when the sensor is exposed to light for a long period of time. By exposing the sensor to light before the application of voltage to the electrodes is started, it is thus possible to prevent any shift of the characteristic curve to the high intensity side or, in other words, to shift the characteristic curve to the low intensity side, so that the exposure time before the application of voltage to the electrodes is started can be regulated to compensate for the reciprocity low failure.

Method for compensating for the reciprocity law failure when exposure time is equal to voltage applying time

In the system of the present invention, the photo-induced current value is not reduced to zero immediately after the exposure of the sensor to light is finished; that is, the photo-induced current continues to flow, albeit decaying slowly. It is thus possible to make efficient use of the photo-induced current by continuing the application of voltage to the electrodes even after the exposure of the sensor to image light is finished. Even when the exposure time is nearly equal to the voltage applying time, the

characteristic curve is often shifted to the high intensity side due to a sensitivity drop, if no efficient use is made of the photo-induced current because the sensor remains exposed to light after the application of voltage to the electrodes has been finished. To avoid this, the exposure of the sensor to image light is started before the application of voltage to the electrodes is started, and the application of voltage thereto is continued even after the exposure of the sensor to image light has been finished. By doing so, it is possible to start the application of voltage to the electrodes at such timing that the photo-induced current is increased by exposure to a certain degree, thereby enabling voltage to be applied to the electrodes in a time zone where an increased photo-induced current is obtained and so achieving an improved sensitivity.

The results of the image recorded by such a method are shown in Fig. 35.

The image was recorded at an applied voltage of 700 volts for an exposure time of 1/15 seconds and a voltage applying time of 65 msec. In an exposure method A, the exposure of the photoelectric sensor to image light was started simultaneously with the application of voltage to the electrodes as illustrated in Fig. 31(a) (shown by X), and in an exposure method B, the application of voltage to the electrodes was started about 30 milliseconds after the start of the exposure of the photoelectric sensor to image light as illustrated in Fig. 34 (shown by O). As can be seen from Fig. 35, the characteristics curve is shifted to a lower

intensity side in the exposure method B than in the exposure method A; in other words, the photo-induced current is more effectively used in B than in A.

Reference will now be made to another method for compensating for the reciprocity law failure.

Compensation by shutter speed and f-number

In another compensating method of the present invention, a displacement of the characteristic curve is predetermined to regulate shutter speed and f-number, so that an image can be recorded in a proper exposure quantity.

Images were recorded at varying exposure times (shutter speeds) of 1/400 sec., 1/250 sec., 1/125 sec., 1/60 sec., 1/30 sec., 1/15 sec., 1/8 sec., 1/4 sec., 1/2 sec., 1 sec., and 2 sec. When the exposure time was longer than 1/8 seconds, the voltage applying and exposure timings were regulated such that the application of voltage to the electrodes was finished at the same time as the exposure of the photoelectric sensor to image light, as shown in Fig. 32, and the exposure of the sensor to light was then started prior to the application of voltage to the electrodes. The voltage applying time was 65 milliseconds (the period of time in which the voltage of the unexposed portion reached the threshold voltage). When the exposure time was 1/15 sec., an image was recorded by starting the application of voltage to the electrodes 30 milliseconds after the start of the exposure of the sensor to image light so that effective use could be made of the photo-induced current, as explained with reference to Fig. 34.

Mast of the results are as shown in Fig. 30. Within the exposure time range of 1/250 to 1/15 sec., the transmittance change of the liquid crystal medium with respect to exposure quantity has an almost equal value and so the reciprocity law can well apply. As the exposure time increases from 1/15 sec., the characteristic curve has a tendency toward being shifted to the high intensity side even when the sensor is exposed to image light before the application of voltage to the electrodes is started. This is believed to be because as exposure time increases, the photo-induced current is unlikely to change linearly, with a decrease in the quantity of the current increase. However, the quantity of the shift, because of being already compensated for and reduced by exposure before the application of voltage to the electrodes is started, is 0.4 to 0.50 log (lux·sec.) in the case of an exposure time of about 2 seconds.

At a high shutter speed, the characteristic curve shows a tendency toward being shifted to the low intensity side.

From these data, it is found that the system of the present invention fails to satisfy the reciprocity law in a high and low shutter speed region, and such a reciprocity law failure must be compensated for. The reciprocity law, because of applying in a wide range of 1/250 to 1/15 seconds, must be compensated for depending on the respective shutter speeds.

The region that fails to satisfy the reciprocity law, and the quantity of the shift are predetermined by such measurement. By regulating the shutter speed and f-number

corresponding to the obtained data, it is possible to record images in a proper exposure quantity.

At a shutter speed of 1/4 seconds for instance, the exposure time becomes about 40% longer than at 1/125 seconds, because the then quantity of the shift is 0.2 log (lux·sec.).

In the case of an image recording system (e.g., a camera), it is often impossible to use a well-controlled proper exposure quantity, because any desired value for shutter speed and f-number cannot be selectively used.

An account will now be given of how this can be compensated for.

High speed shutter

Where the high speed shutter is used, the characteristic curve is shifted to the low intensity side. By varying the exposure and voltage applying timings as mentioned below, it is thus possible to compensate for the exposure quantity. That is, it is preferable to reduce the exposure quantity. The same effect as achieved by the exposure quantity reduction is obtained by starting the application of voltage to the electrodes at the time when the sensor is exposed to image light before the application of voltage to the electrodes is started (rather than when the sensor is exposed to image light at the same time as the application of voltage to the electrodes), as shown in Fig. 36(b), to allow the photo-induced current to decay. The exposure timing may be regulated by determining the timing t_d from the quantity of the shift found from Fig. 30 and the decay curve of the photo-induced current.

By varying the timing t_d and thereby changing the apparent sensitivity, it is likewise possible to preset any desired value for f-number under the same exposure conditions. For instance, when it is desired to open the diaphragm, it is preferable to extend the period of time t_d.

Compensation due to voltage applying conditions

With the method for making compensation for the high speed shutter, it is impossible to make compensation for an extended exposure.

According to the system of the present invention, the characteristic curve can be changed by voltage applying conditions.

As shown in Fig. 30, under the same voltage applying conditions the characteristic curve at a shutter speed of 1/4 seconds is shifted to the high intensity side by 0.2 log (lux·sec.) as compared with that at 1/125 seconds.

Under the voltage applying conditions of 720 volts and 65 milliseconds, an image was recorded in an exposure time of 1/4 seconds. The results are shown in Fig. 37. Due to the applied voltage being high, the transmittance of the liquid crystal medium at the unexposed portion increases. As can be seen from Fig. 38 showing the standardized results of the transmittances of the unexposed portion and the portion exposed to light at high intensity, the characteristic curves coincide with each other. By controlling the voltage applying conditions to place the transmittance of the liquid crystal medium at the unexposed portion under control, it is thus possible to change the characteristic curve. For the

high speed shutter, it is possible to shift the characteristic curve to the high intensity side by lowering the applied voltage or shortening the voltage applying time.

Synchro-flash photography

When the system of the present invention is used as mentioned above, the photoelectric sensor is exposed to image light before the application of voltage to the electrodes is started, so that even when the light used is feeble, an image can be recorded on the recording medium if the sensor is exposed thereto for an extended period of time. For instance, this may be applied to taking a photograph of a person with flash, with a night scene for a background. While the photoelectric sensor is being mainly exposed to light from the background, as shown in Fig. 39, it is possible to photograph the person and background at the same time by producing flash concurrently with the application of voltage to the electrodes. In this case, it is desired that the application of voltage be in synchronism with the emission of flash. To say it another way, if the application of voltage to the electrodes is started after the emission of flash, it is then impossible to make effective use of flash. Also, unless the photoelectric sensor is exposed to image light fairly prior to the start of the application of voltage, it is then impossible to record the background with brightness.

It is here to be noted that when the exposure time is long (about 1.5 to 2 seconds), the photo-induced current is saturated and so does not change. For this reason, no

effective recording of the image is achieved, even when the exposure and voltage applying times are longer than that. When an image is recorded by exposure long enough to cause the photo-induced current to be saturated, it is preferable to use an image recording method as shown in Fig. 40. That is, the application of voltage to the electrodes is started in a time (40 to 50 milliseconds) during which the photo-induced current is saturated, after the exposure of the photoelectric sensor to image light has been started, followed by the interruption of the application of voltage. After an elapse of a certain time, voltage is again applied to the electrodes in a state where the voltages of the photoelectric sensor and liquid crystal medium have sufficiently decayed, so that the image can be effectively recorded on the liquid crystal medium. In Fig. 40, the application of voltage is shown to be repeated twice. However, it is to be understood that the number of the application of voltage is not critical and so may be two or more although depending on exposure time.

Reference will now be made to one general construction of the information recording system with which the image recording method of the present invention is to be carried out.

Fig. 41 shows one general construction of the image recording system according to the present invention. In Fig. 41 reference numerals 101 to 103 represent the measuring means needed for recording images according to the present invention. That is, 101 represents photometric means, 102

means for measuring the base current of the photoelectric sensor and/or the resistance and other physical values of the liquid crystal medium, and 103 input means for photographic conditions such as shutter time and/or f-number, etc. If the base current of the sensor and the resistance and other physical values of the liquid crystal medium are known in advance, they may then have been preset by the input means 103. Reference numeral 104 represents a controller made up of a microcomputer, etc., which can compute and determine shutter time on the basis of the intensity of light measured by the photometeric means 101 and the data obtained by the measuring means 102 (or the input physical values of the photoelectric sensor and liquid crystal medium), and can preset the voltage applying conditions (applied voltage and voltage applying time) as well. The controller 104 enables a power source 30 and a shutter 70 to be controlled at timing (or by a method) suitable for the preset shutter time and voltage applying conditions, so that the exposure of the sensor 10 to light and the application of voltage to the electrodes of the sensor 10 and liquid crystal medium 20 can be well controlled for photography under the optimum conditions. Reference numeral 71 stands for a lens.

An account will now be given of a camera to which the recording method wherein the photoelectric sensor is exposed to light before the application of voltage to the electrodes is started is applied, and its working sequence.

Shown in Fig. 42 is one embodiment of the camera to which the voltage applying and exposure method of the present invention is applied.

In this embodiment, a rotary shutter 67 is built in a single-lens reflex camera 60, and the liquid crystal medium is used in place of conventional film. In association with a power source switch (not shown) that is turned on or off, a mirror 62 is swingable between positions shown by broken and solid lines, respectively. At the position shown by a solid line, the mirror 62 directs light passing through a camera lens system 61 to a penta prism 64, by which the light is directed to an eyepiece 65 which enables the viewer to view the subject and bring it into focus. Upon the power source switch put on for shooting, the mirror 62 is swung up to the position shown by a broken line, so that the light from the subject is directed to a medium holder 69 through the lens system 61, a filter 68 and the rotary shutter 67. The rotary shutter 67 and medium holder 69 are interconnected to a controller 66, so that they can cooperate.

In the medium holder 69, as shown in Fig. 43, a photoelectric sensor 10 is opposed to a liquid crystal recording medium 20 with an air gap of about 9 μm located between them using spacers 16, so that voltage can be applied between the electrodes of the sensor 10 and medium 20 with the electrode of the sensor 10 acting as a positive electrode, and the sensor 10 can be exposed to image light through the substrate. It is here to be noted that the liquid crystal recording medium may be a one-piece type

medium wherein a liquid crystal layer and an electrode layer are stacked on the photoelectric sensor in the described order with or without an interlayer located between the liquid crystal layer and the sensor.

Fig. 44 illustrates one example of the sequence of images. The mirror (a photograph-taking optical system) or the recording medium is moved, during which the shutter is clicked three times to expose the sensor to light for images 1 and 2 before the application of voltage to the electrodes and then expose the sensor to light for image 3 after the application of voltage to the electrodes. In such sequence, images 1-3 can be recorded on the medium at discrete positions.

Fig. 45 is similar to Fig. 44 with the exception that the shutter is kept open while the sensor is exposed to light for images 1-3. In this example, too, images 1-3 can be recorded on the medium at discrete positions.

Fig. 46 is an image sequence according to which images are recorded by a strobo flash. In the same sequence as in Fig. 45, images can be recorded by three strobo flashes.

In the present photoelectric sensor designed such that after the sensor is exposed to information light, voltage is applied between its electrode and the electrode of the information recording medium, or while the sensor is being exposed to information light, the application of voltage between its electrode and the electrode of the information recording medium is intermittently interrupted or the application of voltage thereto is once finished and then

resumed, there is a large conductivity difference between the exposed and unexposed portions, so that even when the light used is feeble, a liquid crystal recording layer can be used to record information with a striking contrast by exposing the photoelectric sensor thereto for an extended period of time. This is because the voltage of the unexposed portion is unlikely to exceed the threshold voltage of liquid crystals.

According to the present invention, it is possible to expose the photoelectric sensor to image light before the start of application of voltage and thereby change the latitude of the recorded image or make compensation for recording sensitivity, so that the reciprocity law required for cameras can be well satisfied.

WHAT WE CLAIM IS:

1. A photoelectric sensor including a photoconductive layer on an electrode and used to record information on an information recording medium, characterized in that when voltage is applied to said sensor after said sensor has been exposed to light with no voltage applied thereto or voltage of opposite polarity applied thereto, a photo-induced current is generated depending on exposure quantity so that the information can be recorded on said information recording medium.

2. A photoelectric sensor including a photo-conductive layer on an electrode and used to record information on an information recording medium, characterized in that said sensor is exposed to information light with voltage applied thereto, whereby the exposed portion is made higher in conductivity than the unexposed portion and the exposed portion is kept still higher in conductivity than the unexposed portion even after the exposure of said sensor to information light has been finished, and while said sensor remains exposed to information light or after the exposure of said sensor to information light has been finished, the application of voltage thereto is interrupted or voltage of opposite polarity is applied thereto, and then the original voltage is again applied thereto, whereby the resulting conductivity is made equal to that obtained by the continued application of voltage.

3. The photoelectric sensor as claimed in Claim 1 or 2, characterized in that when an electric field of 10^5 to 10^6

V/m is applied to said sensor, a current passing through the unexposed portion has a current density of 10^{-4} to 10^{-7} A/cm^2.

4. An image recording method wherein light information is recorded on an information recording medium by exposure to light information, characterized by use of the photoelectric sensor as claimed in Claim 1 or 3 and an information recording medium having an information recording layer formed on an electrode,

the electrode of at least one of said photoelectric sensor and said information recording medium being a transparent electrode, and

said photoelectric sensor being opposed to said information recording medium on the optical axis with a gap located therebetween, or said photoelectric sensor and said information recording medium being stacked on each other with or without a dielectric interlayer located therebetween,

so that after said sensor has been exposed to light information or while said sensor is being exposed to light information, the application of voltage between both said electrodes is started.

5. The information recording method as claimed in Claim 4, characterized in that said information recording medium is a liquid crystal recording medium including on said electrode a liquid crystal-polymer composite material layer comprising liquid crystals and resin.

6. The information recording method as claimed in Claim 5, characterized in that after an elapse of a certain

time upon the exposure of said sensor to light information finished, the application of voltage to both said electrodes is started thereby making the latitude of the recorded image wide.

7. The information recording method as claimed in Claim 6, characterized in that the period of time from the finish of the exposure of said sensor to light information to the start of the application of voltage to both said electrodes is 0 to 500 milliseconds.

8. An image recording method wherein light information is recorded on an information recording medium by exposure to information light, characterized by use of a photoelectric sensor as claimed in Claim 2 or 3 and an information recording medium including an information recording layer formed on an electrode,

the electrode of at least one of said photoelectric sensor and said information recording medium being a transparent electrode, and

said photoelectric sensor being opposed to said information recording medium on the optical axis with a gap located therebetween, or said photoelectric sensor and said information recording medium being stacked upon each other with or without a dielectric interlayer located therebetween,

so that said sensor is exposed to light information, and while said sensor is being exposed to light information or after said sensor has been exposed to light information, the period of time wherein no voltage is applied to both said

electrodes or the period of time wherein voltage of opposite polarity is applied to both said electrodes is provided.

9. The information recording method as claimed in Claim 8, characterized in that said information recording medium is a liquid crystal recording medium including on said electrode a liquid crystal-polymer composite material layer comprising liquid crystals and resin.

10. An image recording method wherein light information is recorded on an information recording medium by exposure to light information, wherein the photoelectric sensor and an information recording medium having an information recording layer formed on an electrode are used,

the electrode of at least one of said photoelectric sensor and said information recording medium being a transparent electrode, and

said photoelectric sensor being opposed to said information recording medium on the optical axis with a gap located therebetween, or said photoelectric sensor and said information recording medium being stacked on each other with or without a dielectric interlayer located therebetween,

so that said sensor is exposed to light information and voltage is applied between both electrodes of said sensor and said recording medium to record information thereon, characterized in that:

the exposure of said sensor to image light and the application of voltage to both said electrodes are properly achieved in response to shutter speed, so that the reciprocity law can be satisfied over a wide range.

11. The information recording method as claimed in Claim 10, characterized in that said information recording medium is a liquid crystal recording medium including on said electrode a liquid crystal-polymer composite material layer comprising liquid crystals and resin.

12. The information recording method as claimed in Claim 11, characterized in that f-number or exposure time is corrected on the basis of the predetermined relation between the shutter speed and the recording properties, so that the reciprocity law can be satisfied over a wide range.

13. The information recording method as claimed in Claim 11, characterized in that a reciprocity law failure is compensated for by starting the exposure of the photoelectric sensor as claimed in Claim 1 or 3 to image light prior to starting the application of voltage to both said electrodes.

14. The information recording method as claimed in Claim 11, characterized in that the period of time wherein no voltage is applied to both said electrodes or the period of time wherein voltage of opposite polarity is applied to both said electrodes is provided while the photoelectric sensor claimed in Claim 2 or 3 is being exposed to image light or after the exposure of said sensor to image light has been finished, thereby compensating for a reciprocity law failure.

15. The information recording method as claimed in Claim 11, characterized in that the application of voltage to both said electrodes is started after an elapse of a certain time upon the exposure of the photoelectric sensor as claimed in Claim 1 or 3 to image light finished.

16. The information recording method as claimed in Claim 11, characterized in that the applied voltage and/or the voltage applying time are controlled, thereby compensating for a reciprocity law failure.

17. An image recording system wherein light information is recorded on an information recording medium by exposure to information light, characterized by comprising a photoelectric sensor including an electrode and an information recording medium having an information recording layer formed on an electrode,

the electrode of at least one of said photoelectric sensor and said information recording medium being a transparent electrode, and

said photoelectric sensor being opposed to said information recording medium on the optical axis with a gap located therebetween, or said photoelectric sensor and said information recording medium being stacked on each other with or without a dielectric interlayer located therebetween, and

a mechanism for starting the application of voltage between both said electrodes after said sensor has been exposed to light information or while said sensor is being exposed to light information.

18. An information recording system constructed from a one-piece type medium comprising a photoelectric sensor having a photoconductive layer stacked on a transparent electrode, an information recording medium having an information recording layer stacked on an electrode and an upper electrode, said photoelectric sensor being opposed to

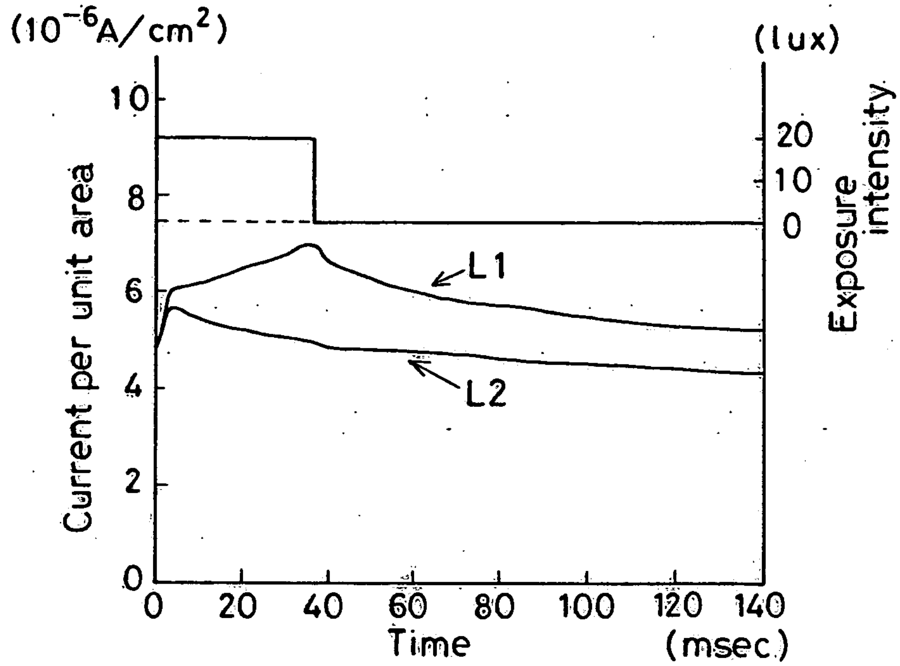
said information recording medium on the optical axis with a gap located therebetween, or said photoelectric sensor and said information recording medium being stacked upon each other with or without a dielectric interlayer located therebetween, wherein said photoelectric sensor is exposed to image light and voltage is applied between both said electrodes to record image or other information on said information recording medium in response to exposure quantity, characterized by further including means for measuring exposure intensity to calculate exposure time and/or input means for exposure time, and having a function of controlling a shutter and a power source under proper conditions in response to the exposure time, thereby allowing the reciprocity law to be satisfied over a wide range of exposure time.

ABSTRACT

A photoelectric sensor having a photoconductive layer stacked on an electrode is opposed to an information recording medium having an information recording layer stacked on an electrode, on which layer information can be recorded by an electric field or electric charge. After the sensor is exposed to information light, voltage is applied between the electrode of the sensor and the electrode of the recording medium. Alternatively, while the sensor is being exposed to information light, the application of voltage between the electrode of the sensor and the electrode of the recording medium is interrupted or the application of voltage thereto is resumed after the application of voltage of opposite polarity. Thus, a large conductivity difference occurs between the exposed and unexposed portions. Therefore, even when the light used is feeble, it is possible to record information with a striking contrast by exposing the sensor thereto for an extended period of time.

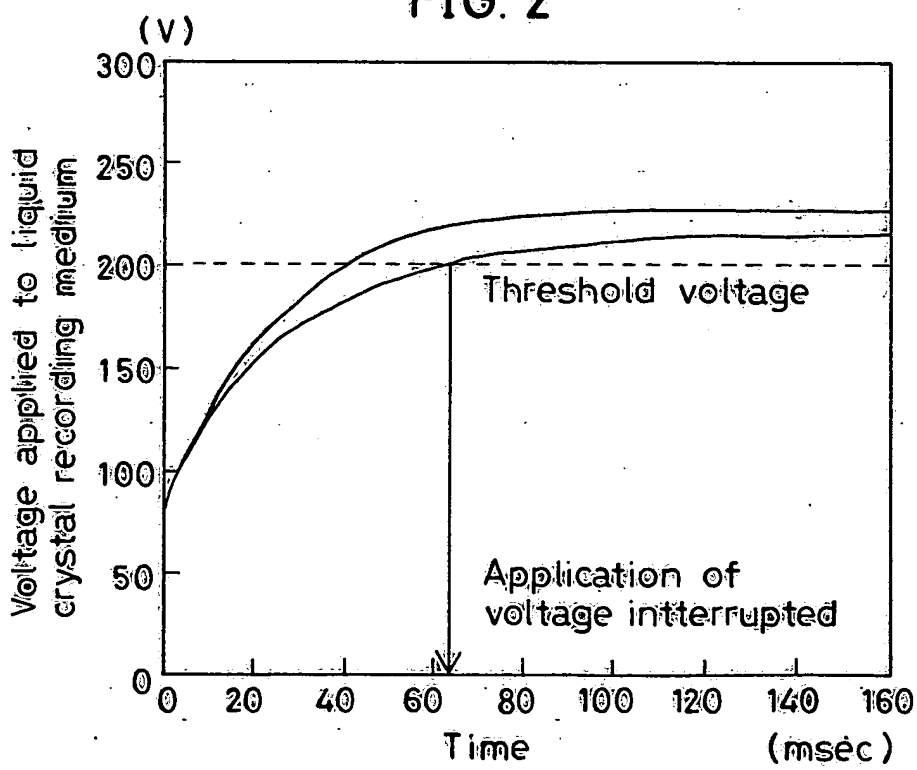
In the invention the sensor is exposed to image light before the start of application of voltage to both electrodes. In this case, the latitude of the recorded image can be changed by changing the time difference. The recording method of the invention can be so corrected that the reciprocity law needed for cameras can be satisfied.

FIG. 1



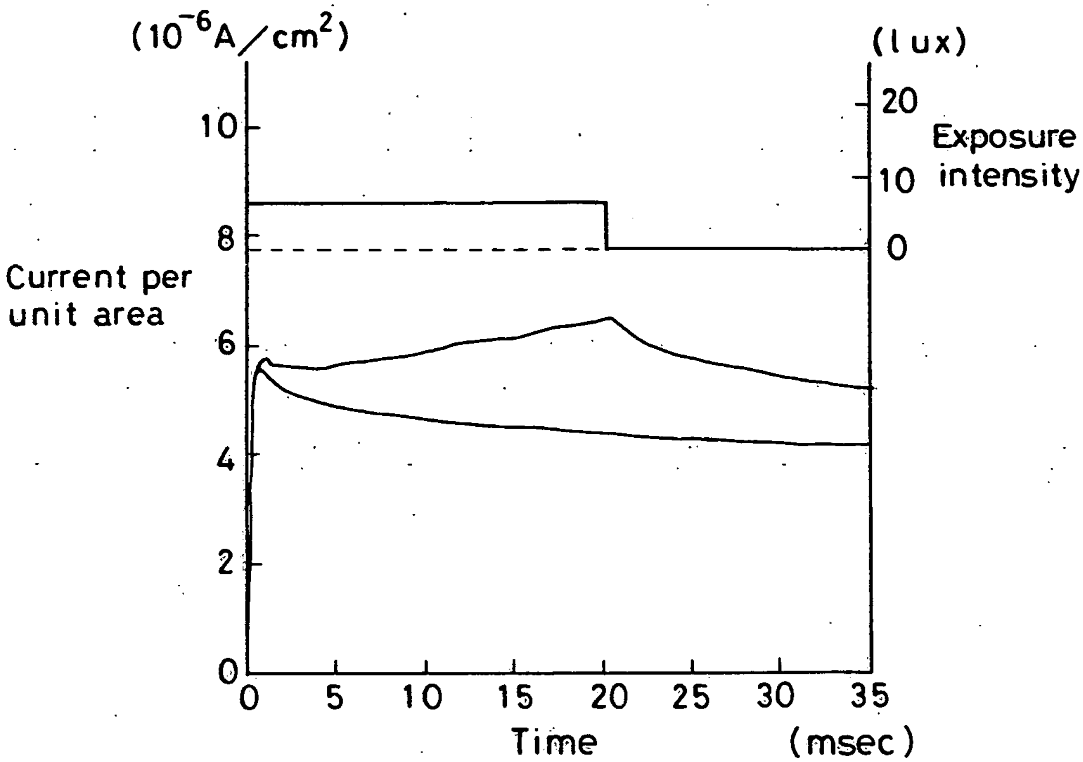
$(10^{-6}A/cm^2)$
(lux)
Current per unit area
Exposure intensity
10
8
6
4
2
0
20
10
0
L1
L2
0
20
40
60
80
100
120
140
Time
(msec)

FIG. 2



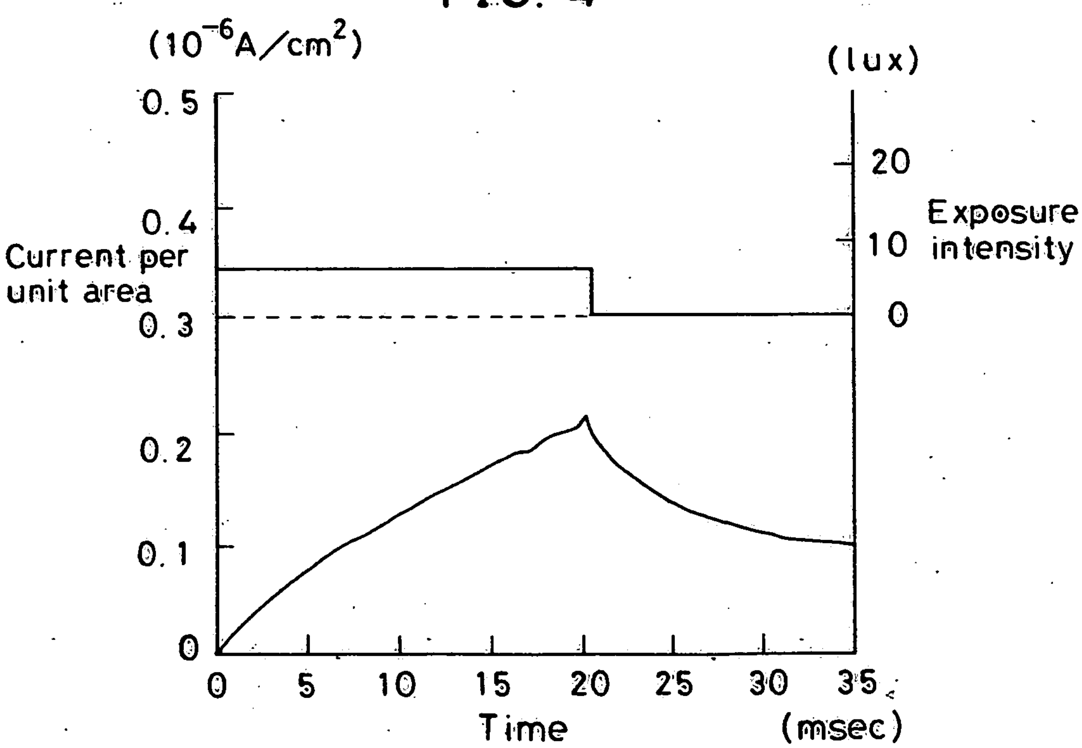
(V)
Voltage applied to liquid crystal recording medium
300
250
200
150
100
50
0
Threshold voltage
Application of voltage intterrupted
0
20
40
60
80
100
120
140
160
Time
(msec)

FIG. 3



(10^{-6}A/cm^2)
(lux)
10
8
6
4
2
0
20
10
0
Exposure intensity
Current per unit area
0 5 10 15 20 25 30 35
Time
(msec)

FIG. 4



(10^{-6}A/cm^2)
(lux)
0.5
0.4
0.3
0.2
0.1
0
20
10
0
Exposure intensity
Current per unit area
0 5 10 15 20 25 30 35
Time
(msec)

FIG. 5

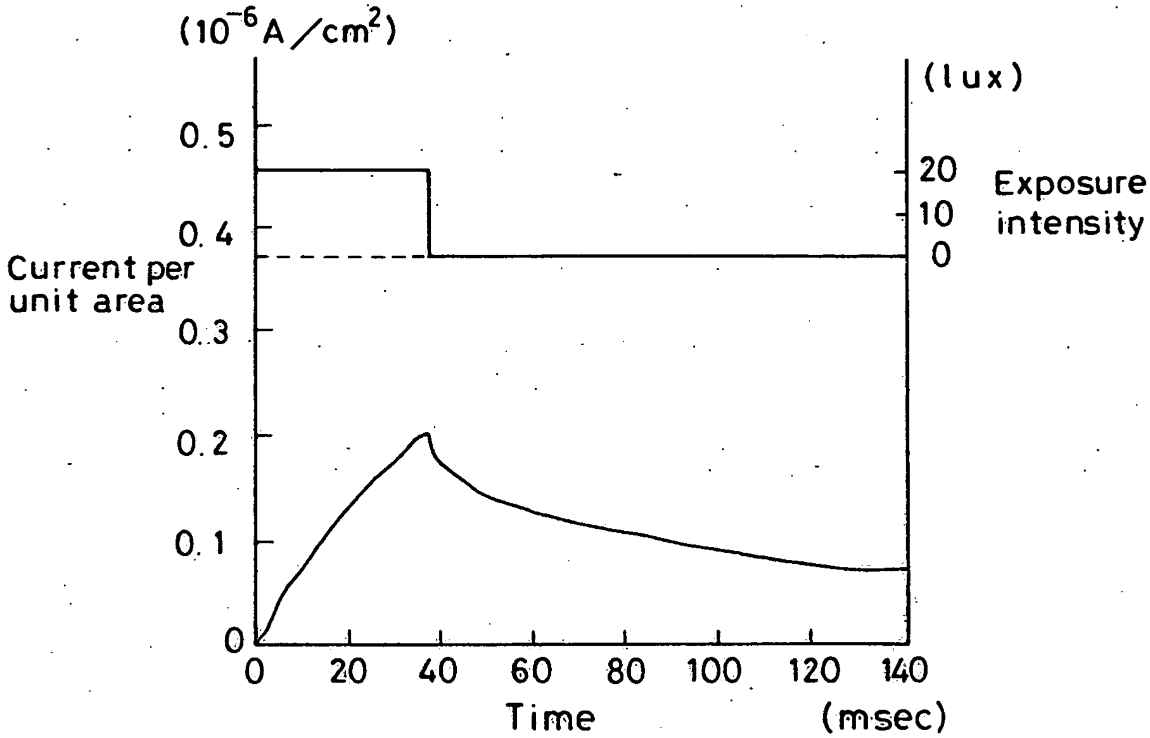


FIG. 6

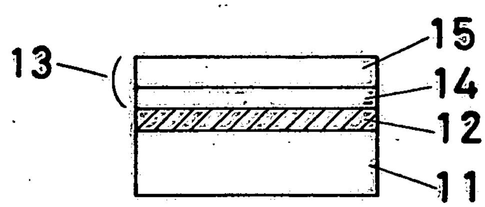


FIG. 7

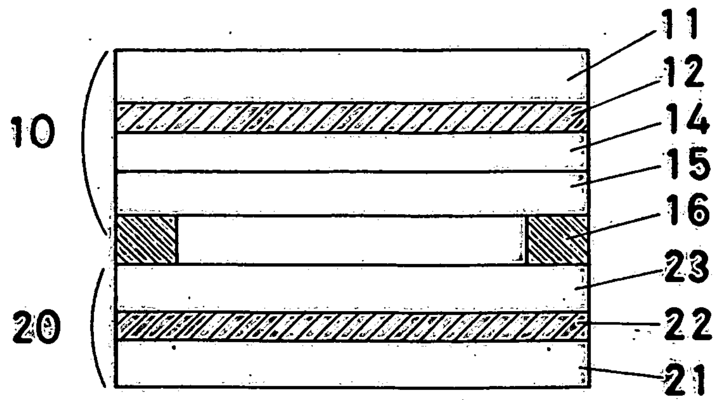


FIG. 8

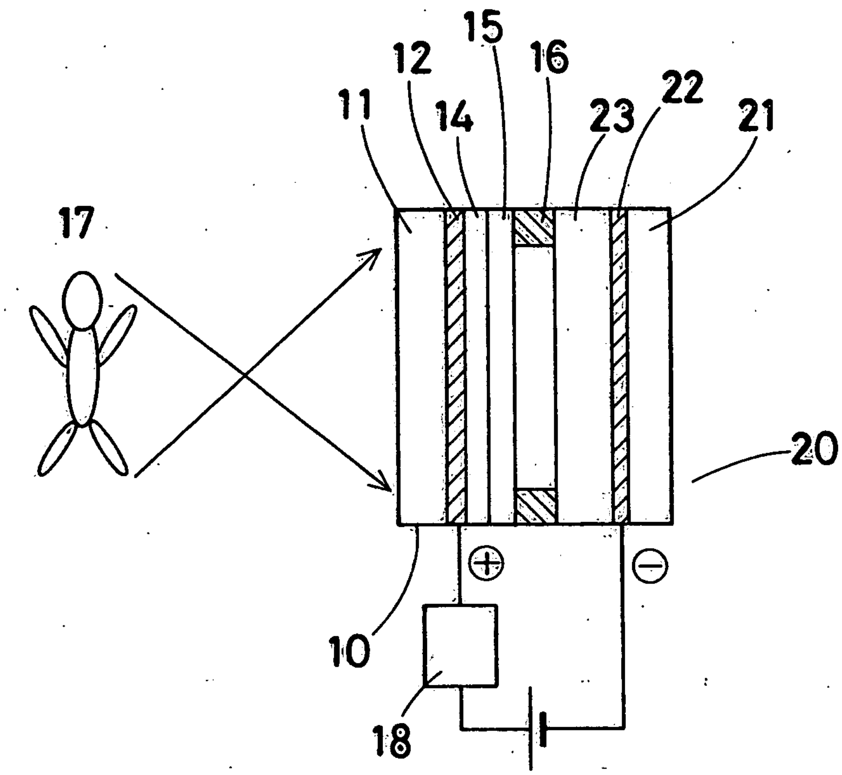


FIG. 9

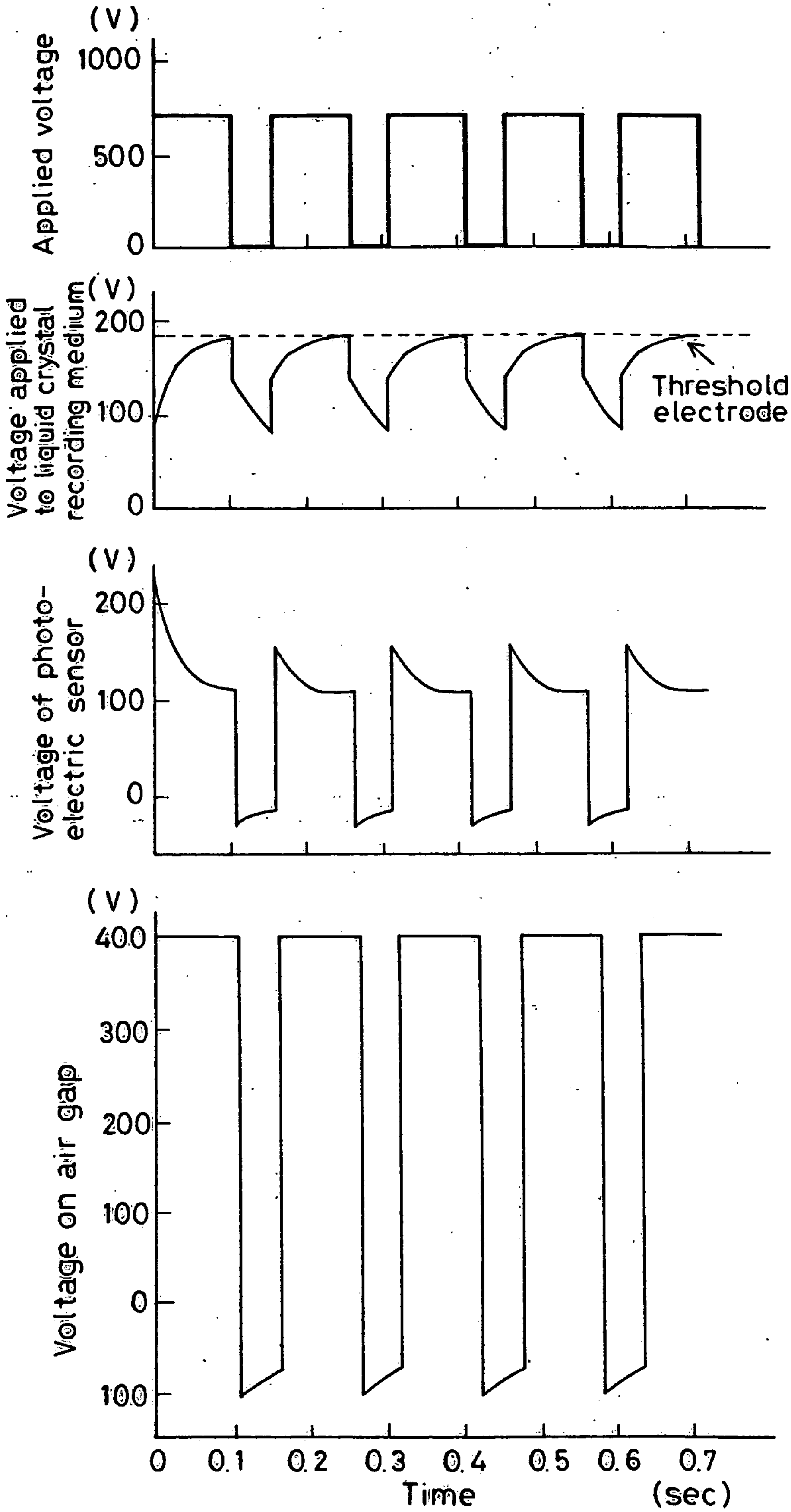

(V)
1000
500
0
Applied voltage
(V)
200
100
0
Voltage applied to liquid crystal recording medium
Threshold electrode
(V)
200
100
0
Voltage of photo-electric sensor
(V)
400
300
200
100
0
100
Voltage on air gap
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Time
(sec)

FIG. 10

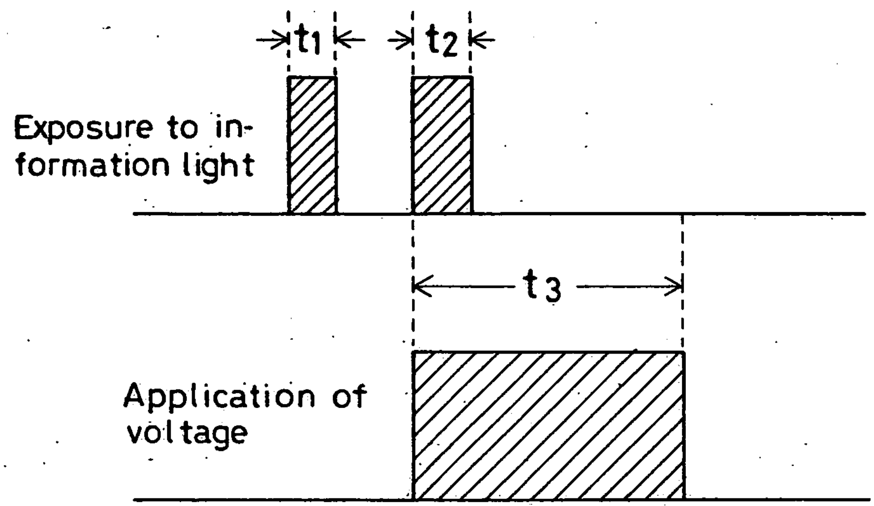

t1
t2
Exposure to information light
t3
Application of voltage

FIG. 11

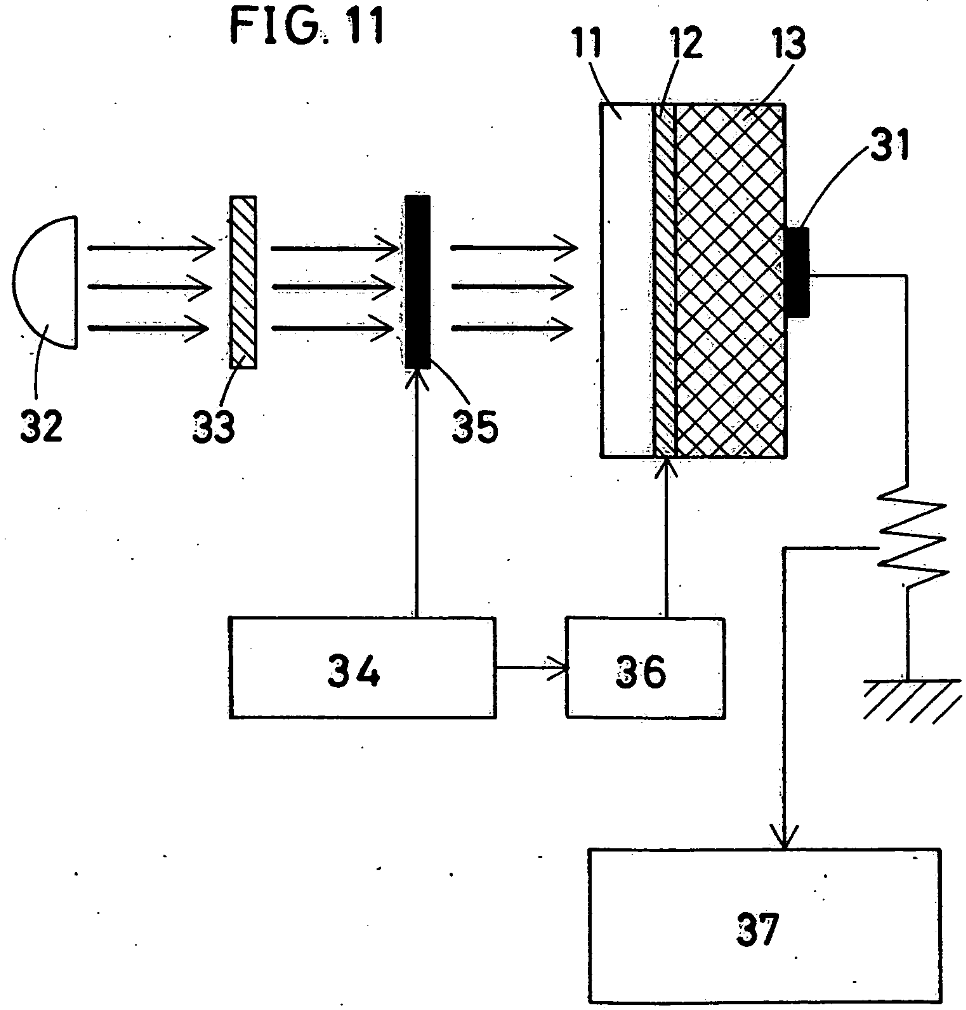
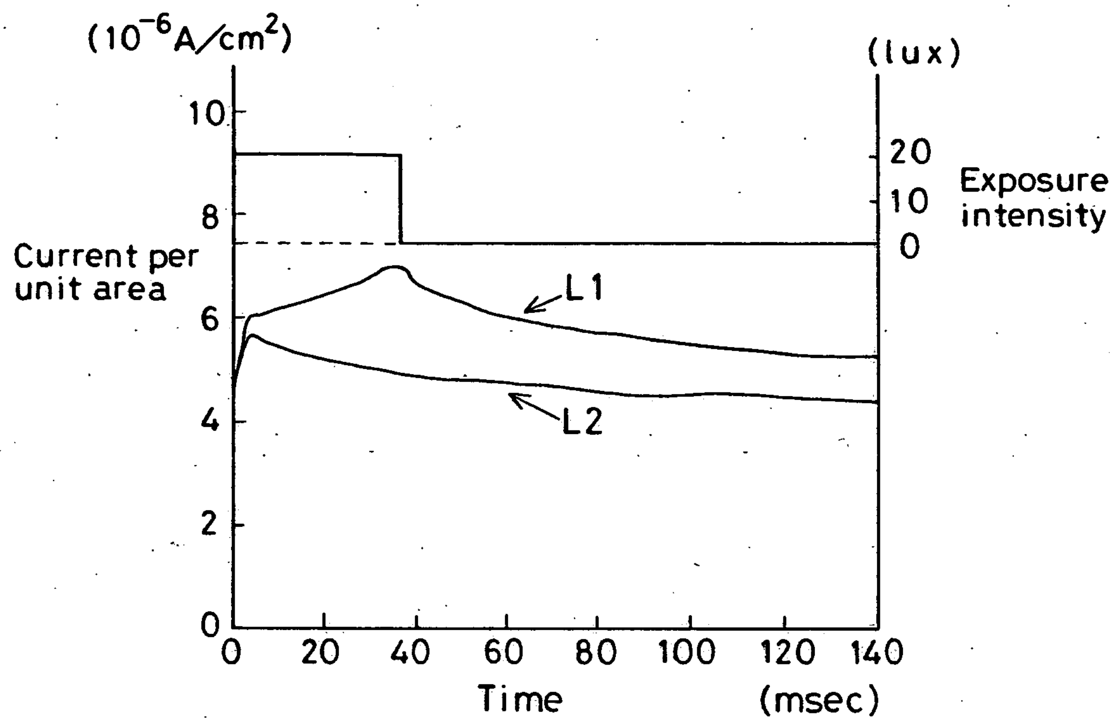
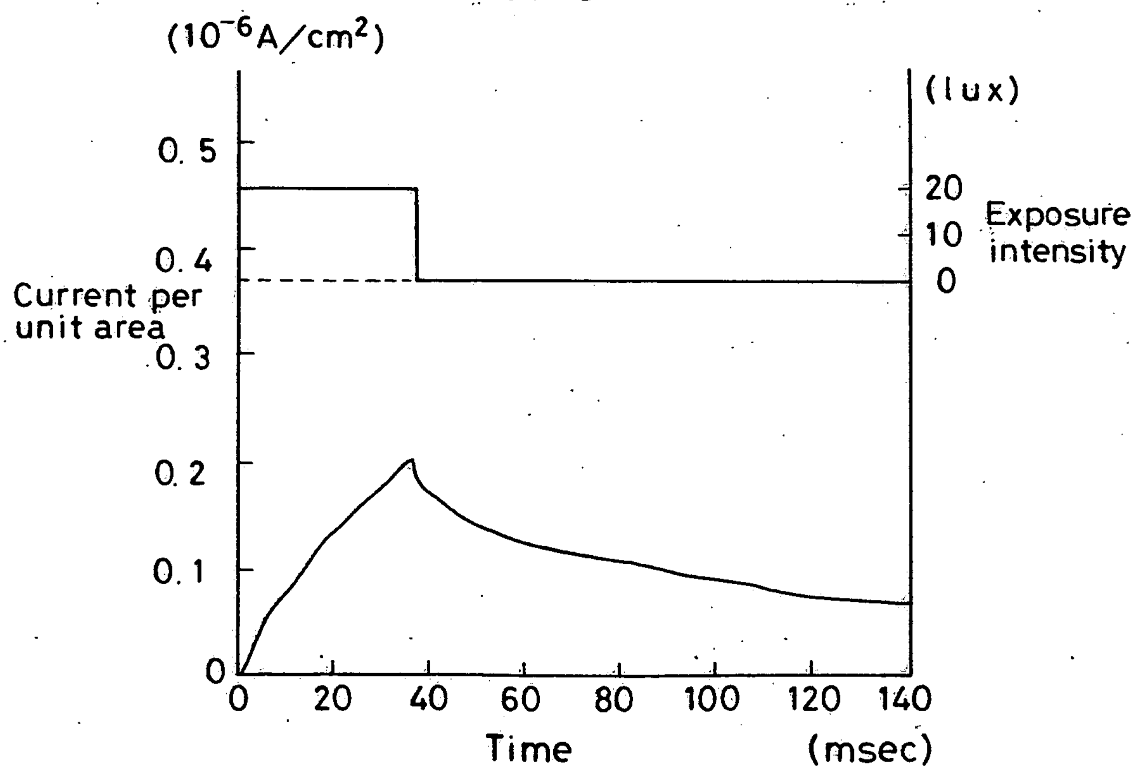

11
12
13
31
32
33
35
34
36
37

FIG. 12



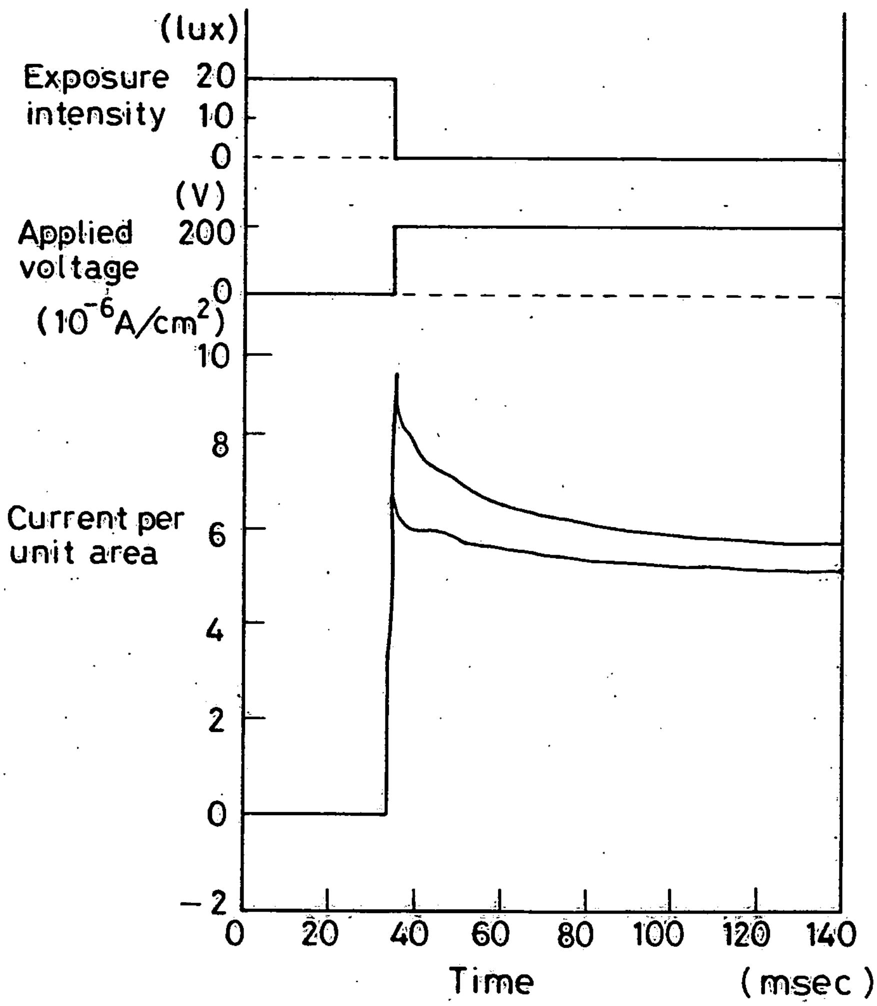
$(10^{-6}A/cm^2)$
(lux)
Current per unit area
Exposure intensity
L1
L2
0
2
4
6
8
10
0
10
20
0
20
40
60
80
100
120
140
Time
(msec)

FIG.13



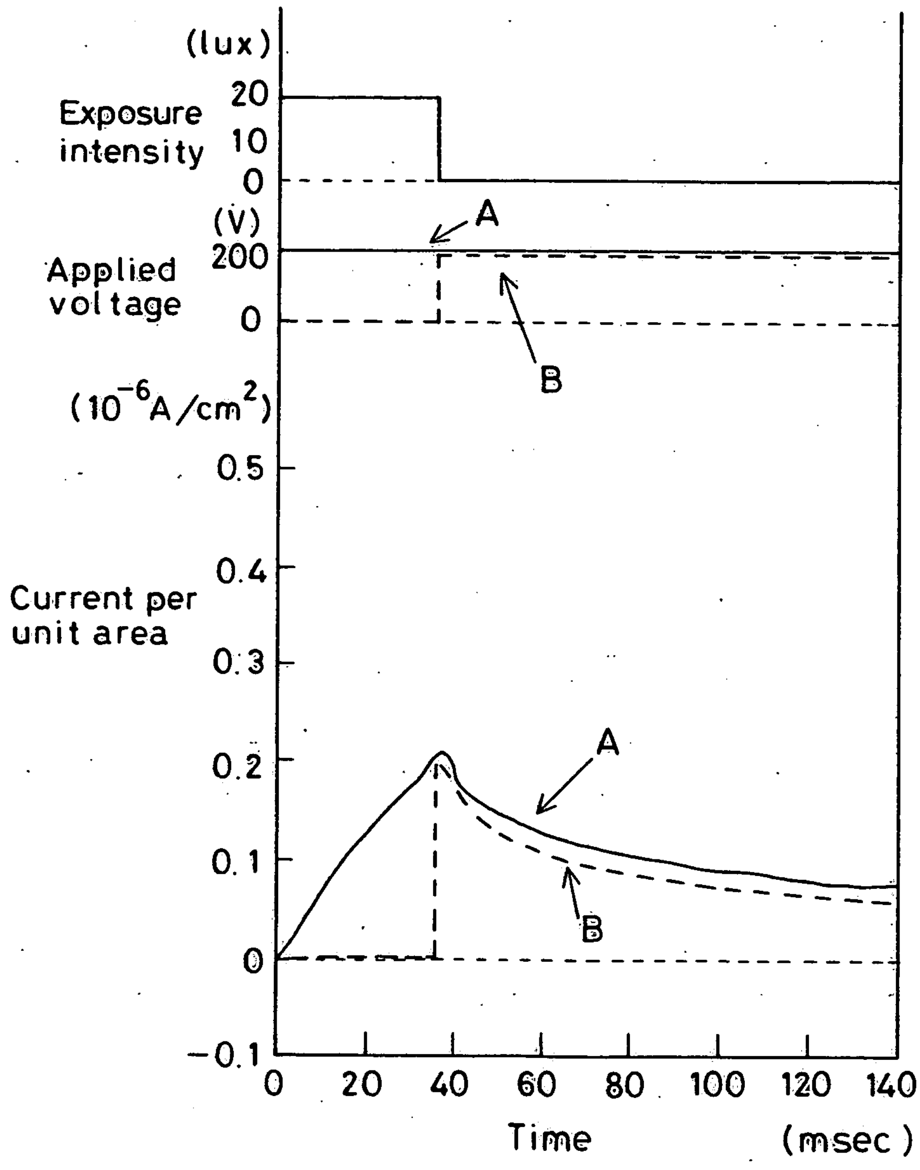
$(10^{-6}A/cm^2)$
(lux)
Current per unit area
Exposure intensity
0
0.1
0.2
0.3
0.4
0.5
0
10
20
0
20
40
60
80
100
120
140
Time
(msec)

FIG. 14



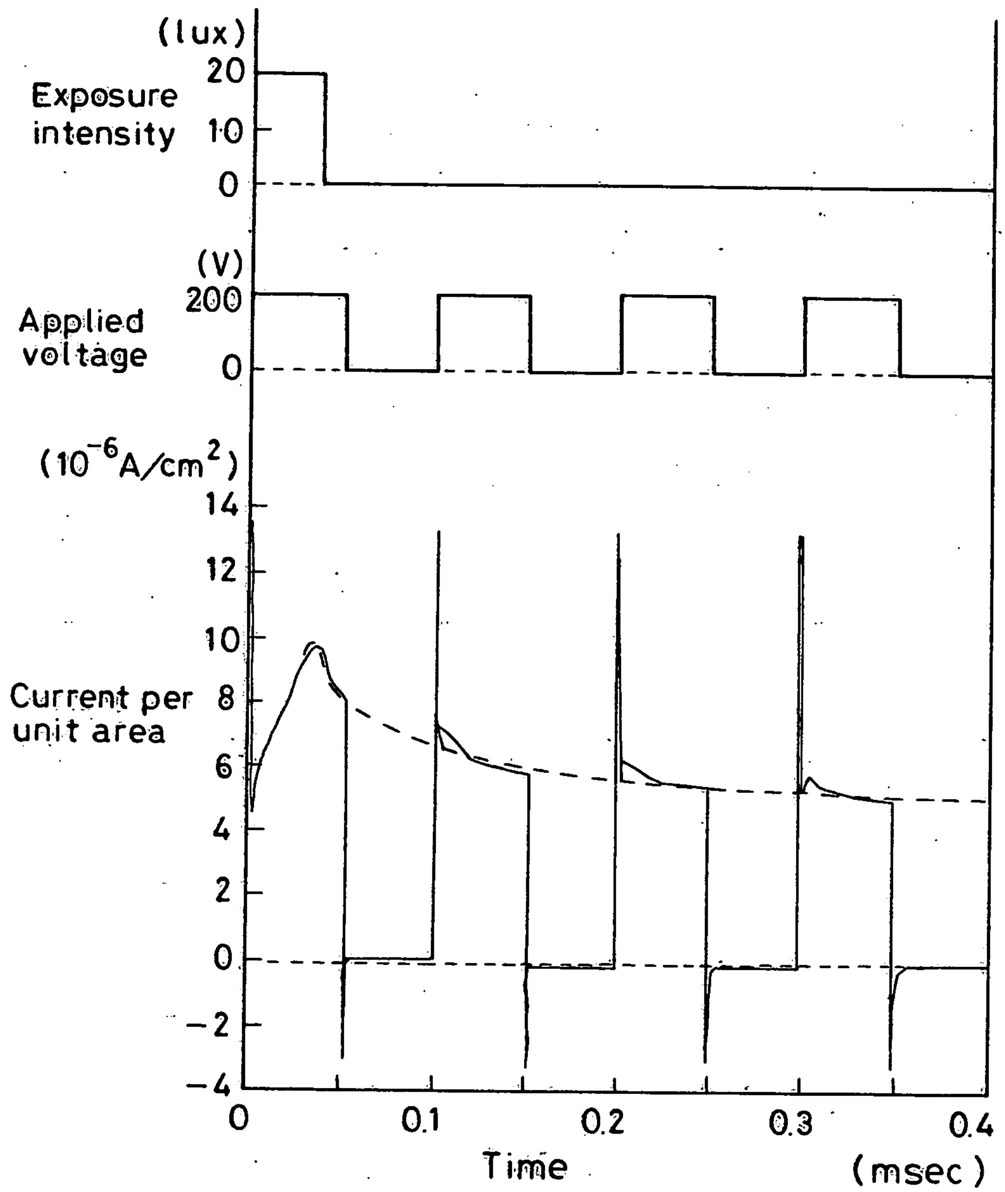
(lux)
Exposure intensity
20
10
0
(V)
Applied voltage
200
0
(10^{-6}A/cm^2)
10
8
Current per unit area
6
4
2
0
− 2
0
20
40
60
80
100
120
140
Time
(msec)

FIG. 15



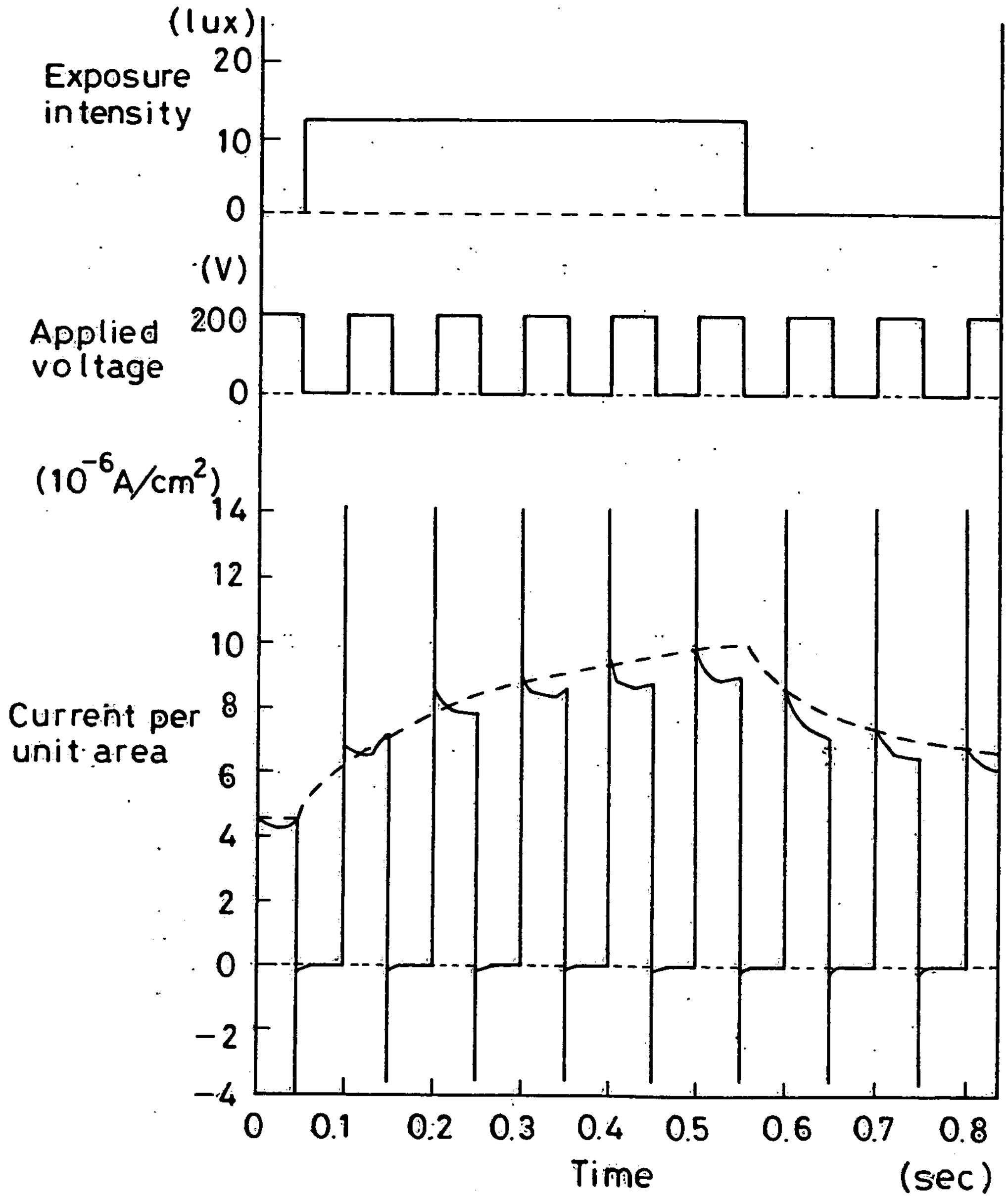
(lux)
Exposure intensity
20
10
0
(V)
A
Applied voltage
200
0
B
(10^{-6}A/cm^2)
0.5
0.4
Current per unit area
0.3
0.2
A
0.1
B
0
−0.1
0
20
40
60
80
100
120
140
Time
(msec)

FIG. 16



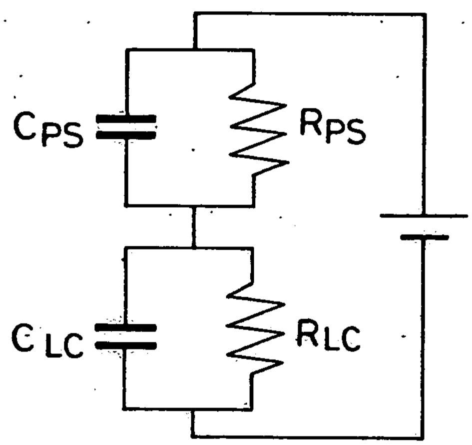
(lux)
20
Exposure intensity
10
0
(V)
200
Applied voltage
0
(10^{-6} A/cm^2)
14
12
10
Current per unit area
8
6
4
2
0
−2
−4
0
0.1
0.2
0.3
0.4
Time
(msec)

FIG. 17



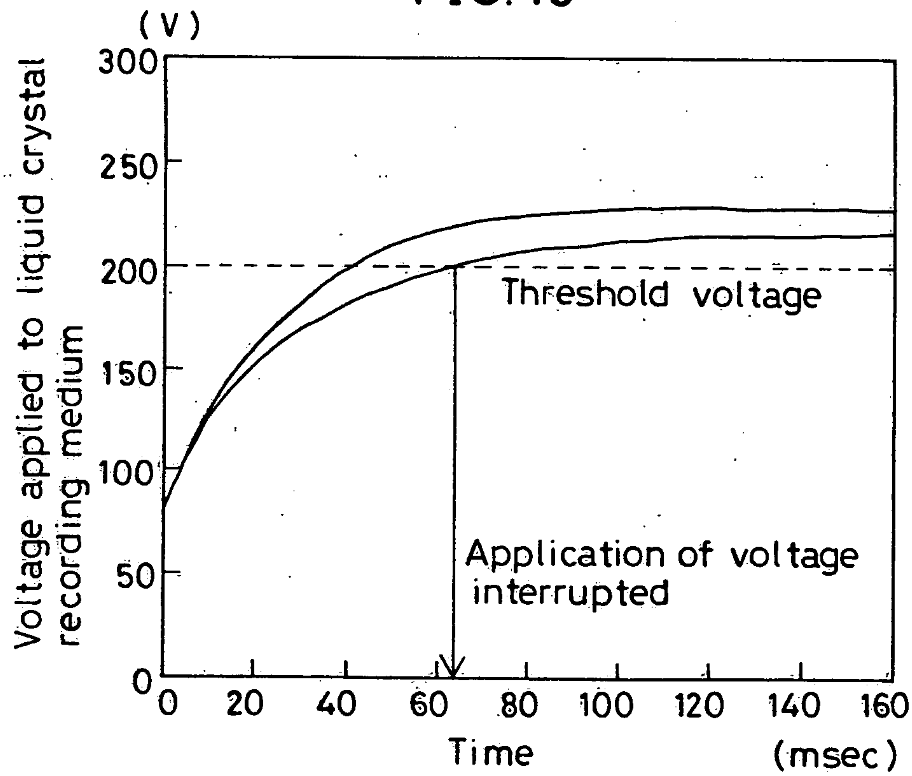
(lux)
20
Exposure intensity
10
0
(V)
Applied voltage
200
0
$(10^{-6}A/cm^2)$
14
12
10
Current per unit area
8
6
4
2
0
−2
−4
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Time
(sec)

FIG. 18



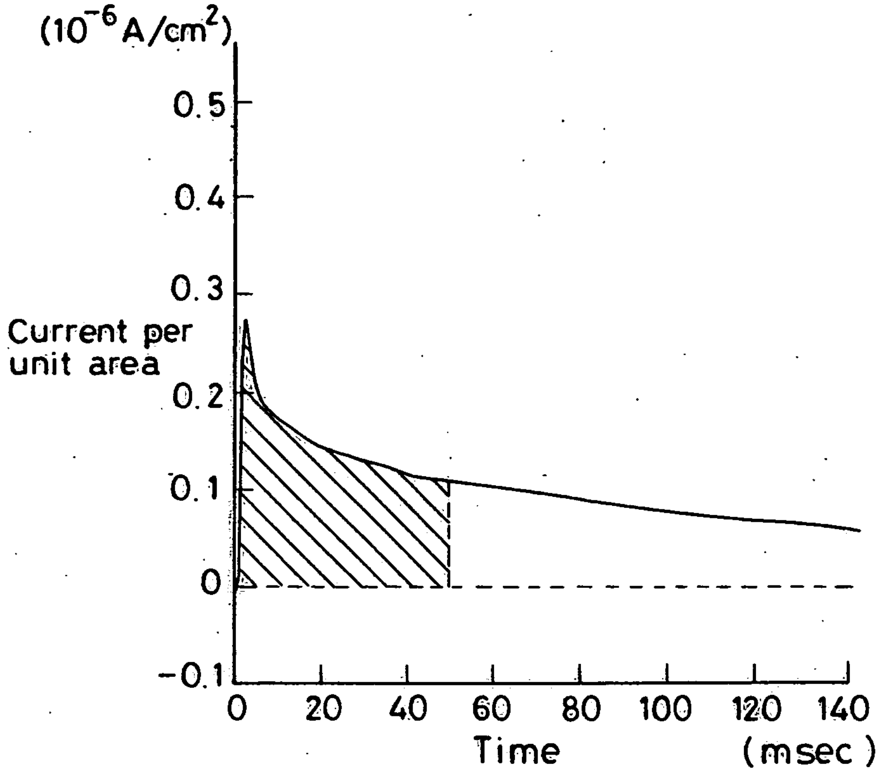
C_{PS}
R_{PS}
C_{LC}
R_{LC}

FIG. 19



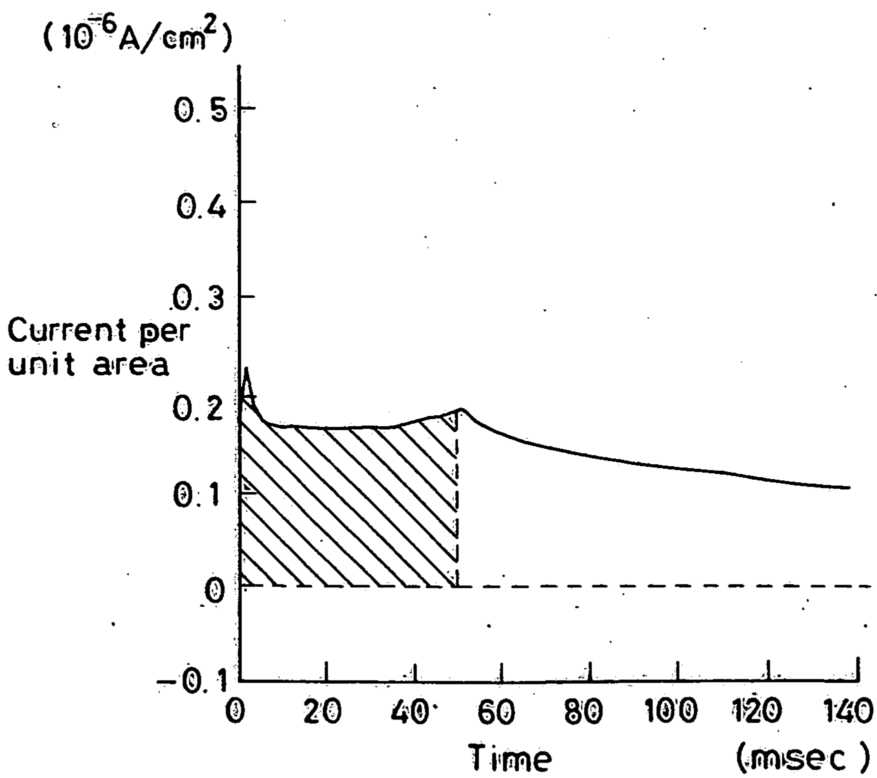
(V)
300
250
200
150
100
50
0
Voltage applied to liquid crystal recording medium
Threshold voltage
Application of voltage interrupted
0
20
40
60
80
100
120
140
160
Time
(msec)

FIG. 20



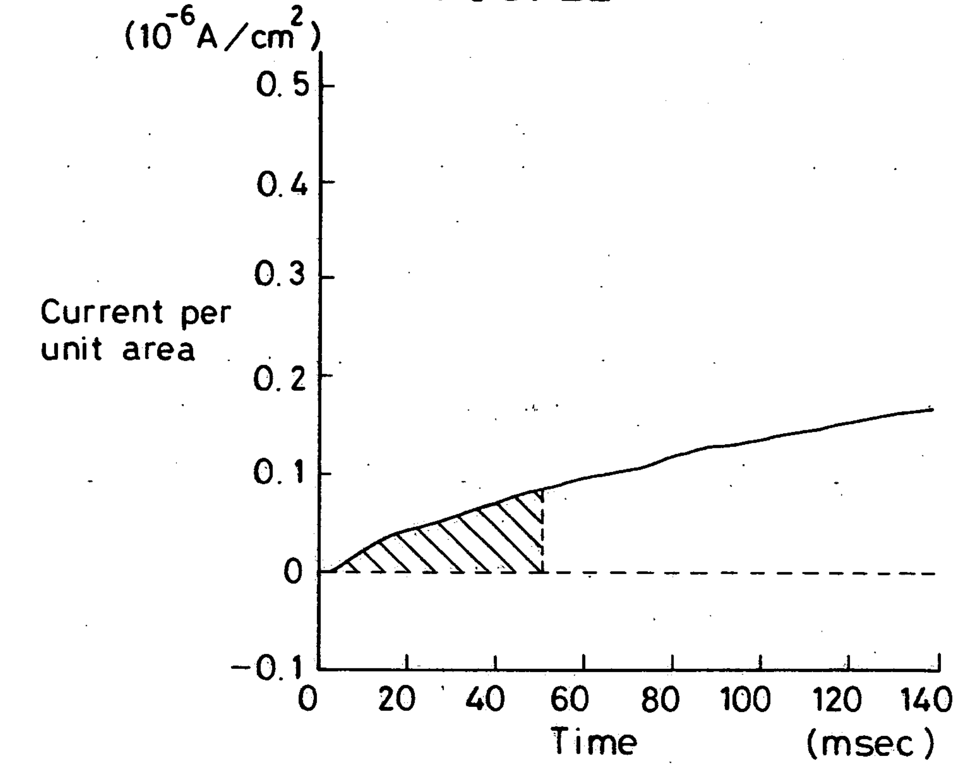
(10⁻⁶ A/cm²)
0.5
0.4
0.3
Current per unit area
0.2
0.1
0
−0.1
0
20
40
60
80
100
120
140
Time
(msec)

FIG. 21



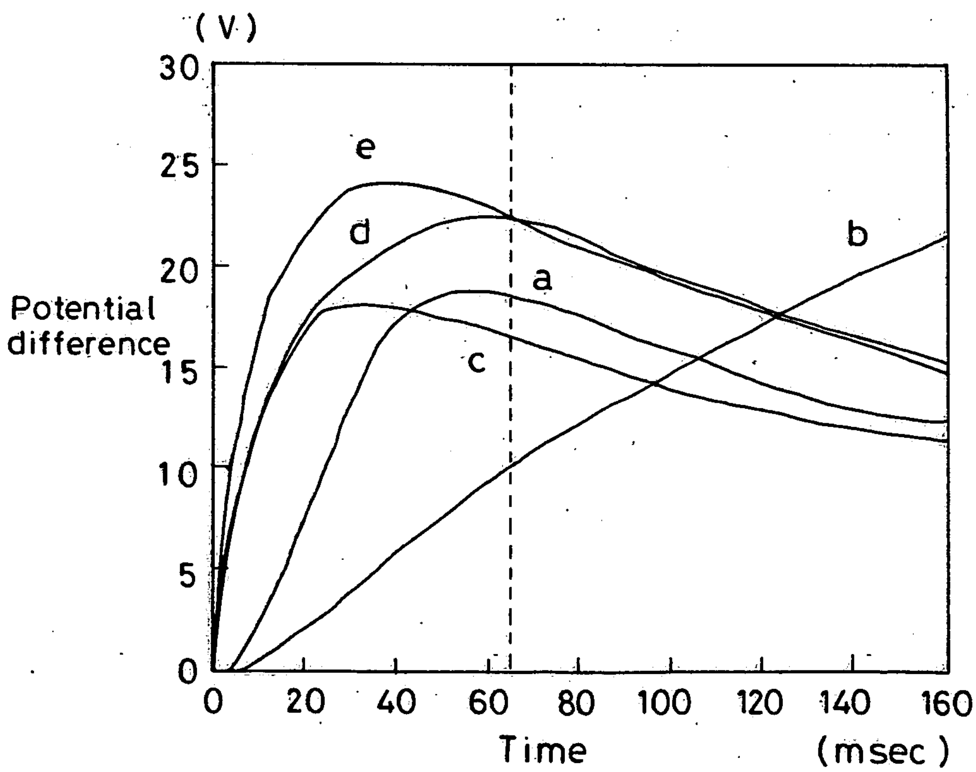
(10⁻⁶ A/cm²)
0.5
0.4
0.3
Current per unit area
0.2
0.1
0
−0.1
0
20
40
60
80
100
120
140
Time
(msec)

FIG. 22



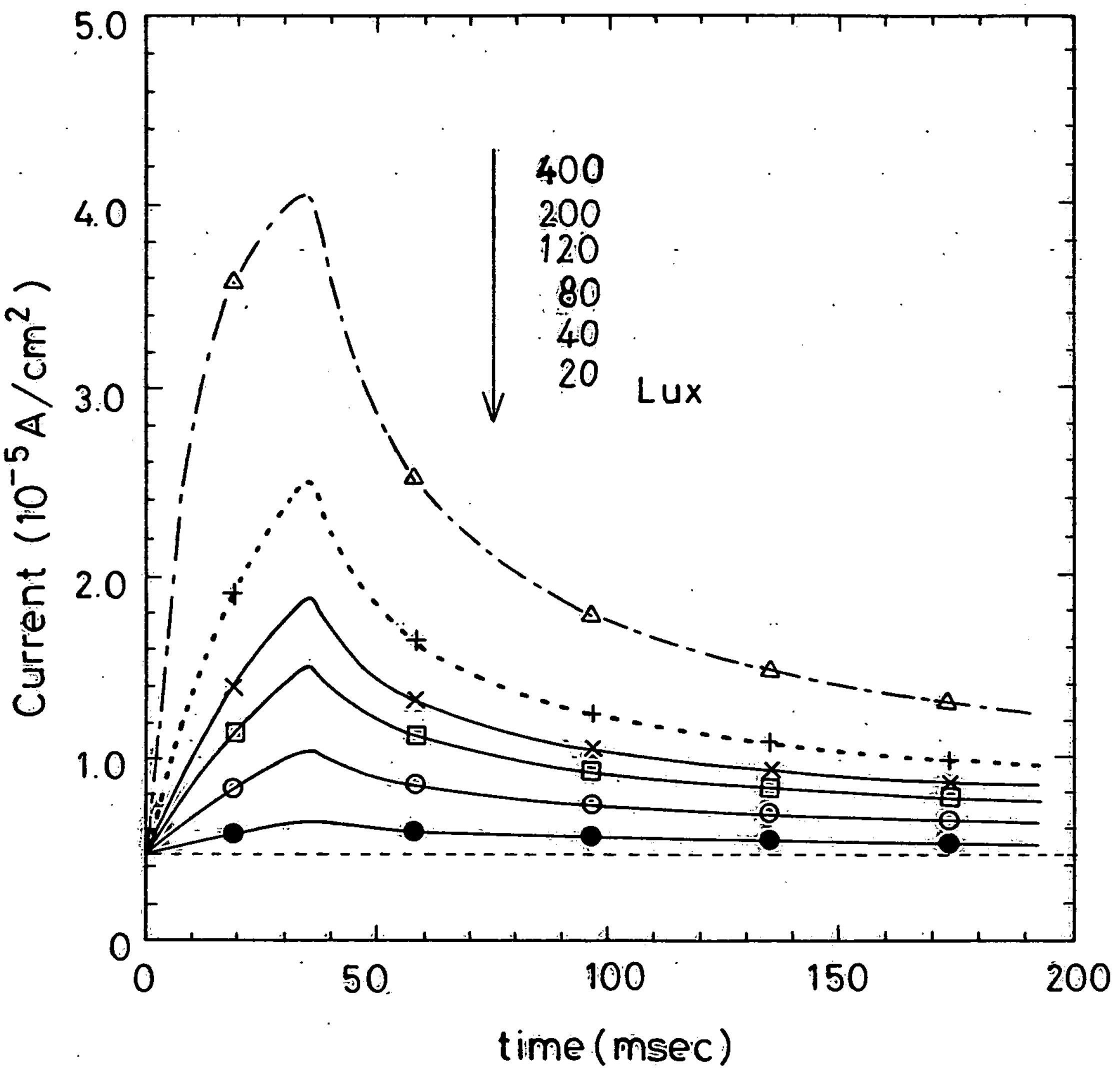
(10^{-6}A/cm^2)
0.5
0.4
0.3
Current per unit area
0.2
0.1
0
-0.1
0
20
40
60
80
100
120
140
Time
(msec)

FIG. 23



(V)
30
25
20
Potential difference
15
10
5
0
e
d
a
b
c
0
20
40
60
80
100
120
140
160
Time
(msec)

FIG. 24



5.0
4.0
3.0
2.0
1.0
0
Current (10^{-5}A/cm^2)
0
50
100
150
200
time (msec)
400
200
120
80
40
20
Lux

FIG. 25

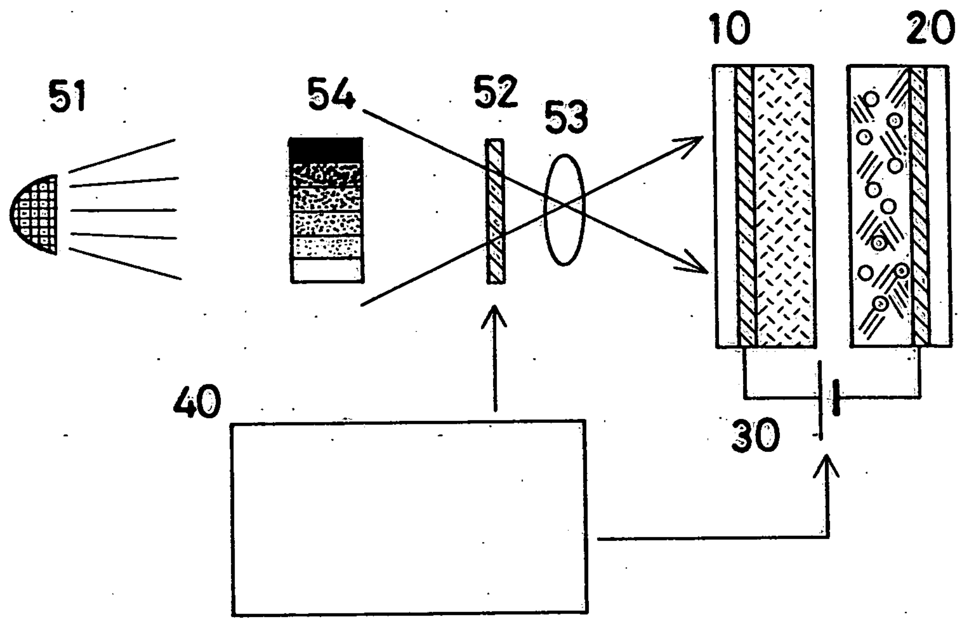

10
20
51
54
52
53
40
30

FIG. 26

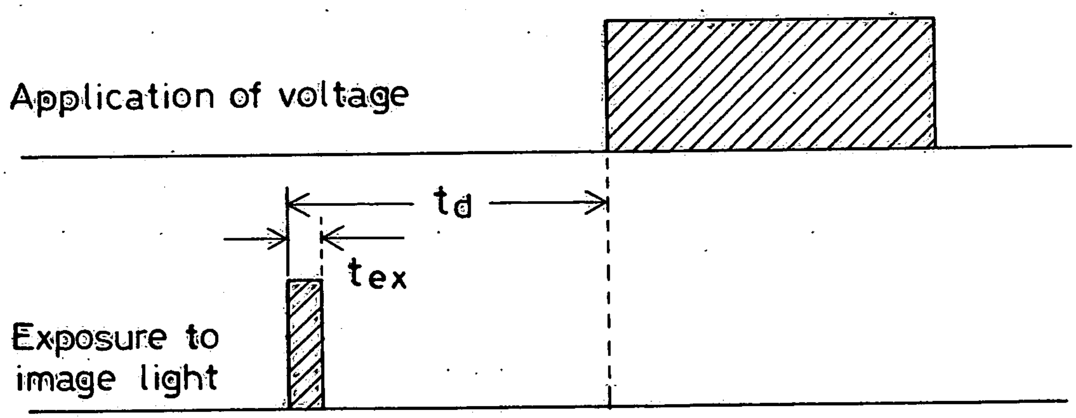
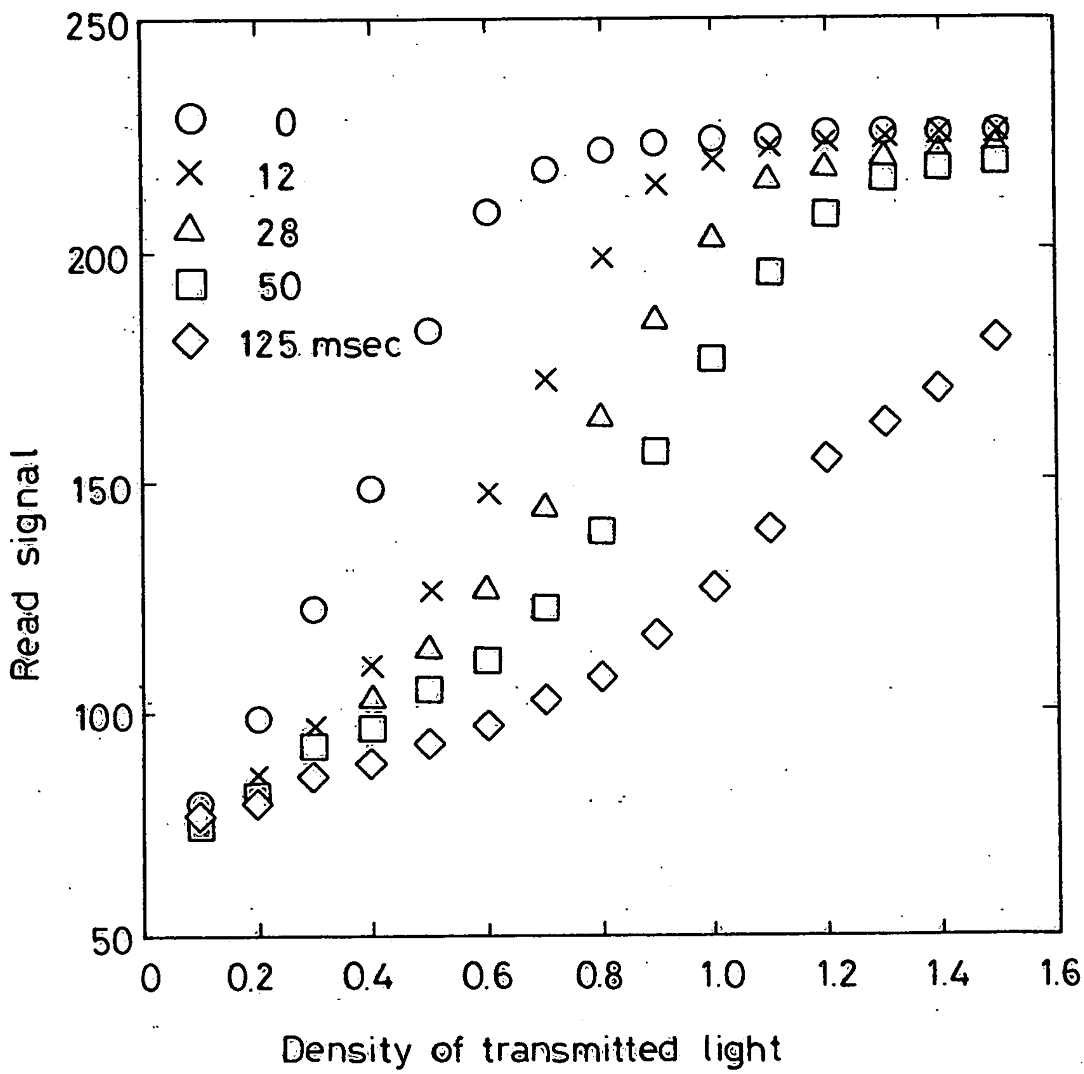
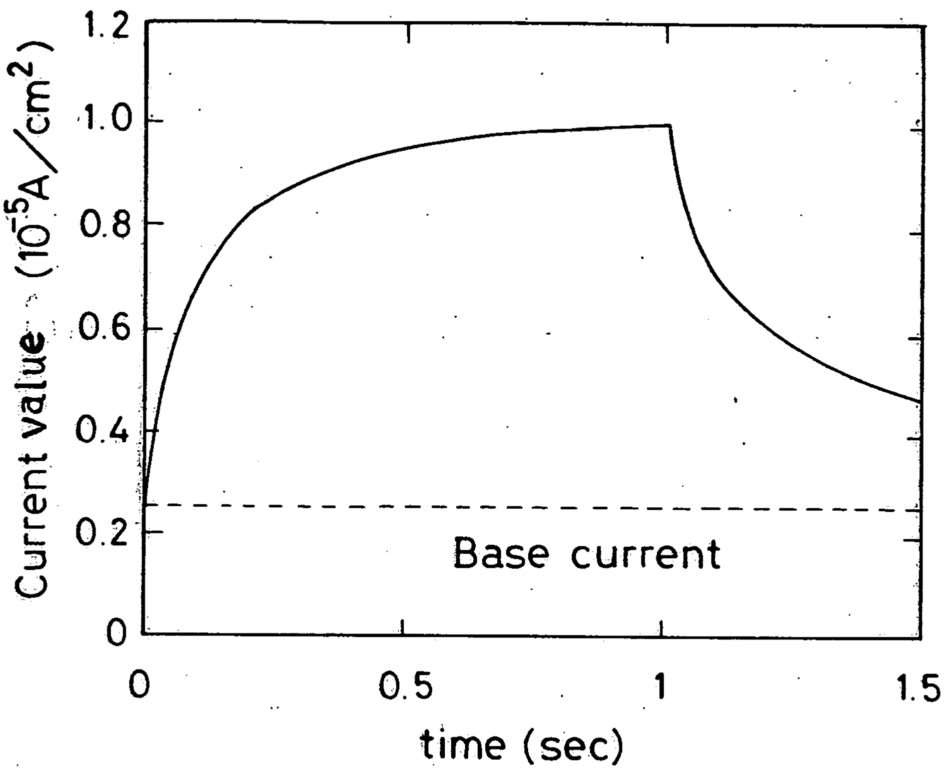

Application of voltage
t_d
t_{ex}
Exposure to image light

FIG. 27



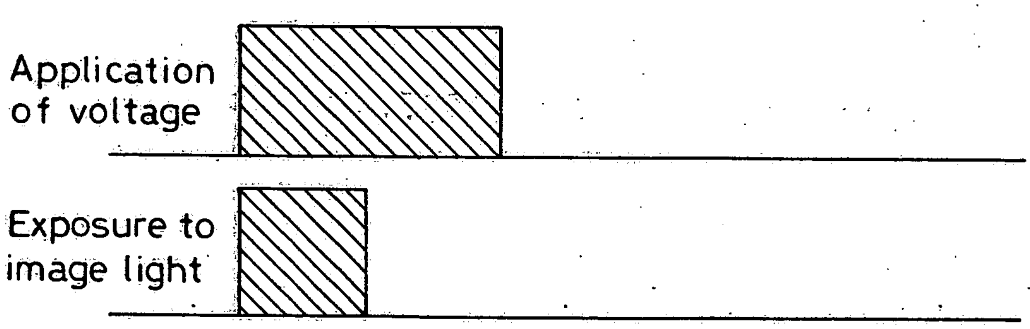
250
200
150
100
50
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
0
12
28
50
125 msec
Read signal
Density of transmitted light

FIG. 28



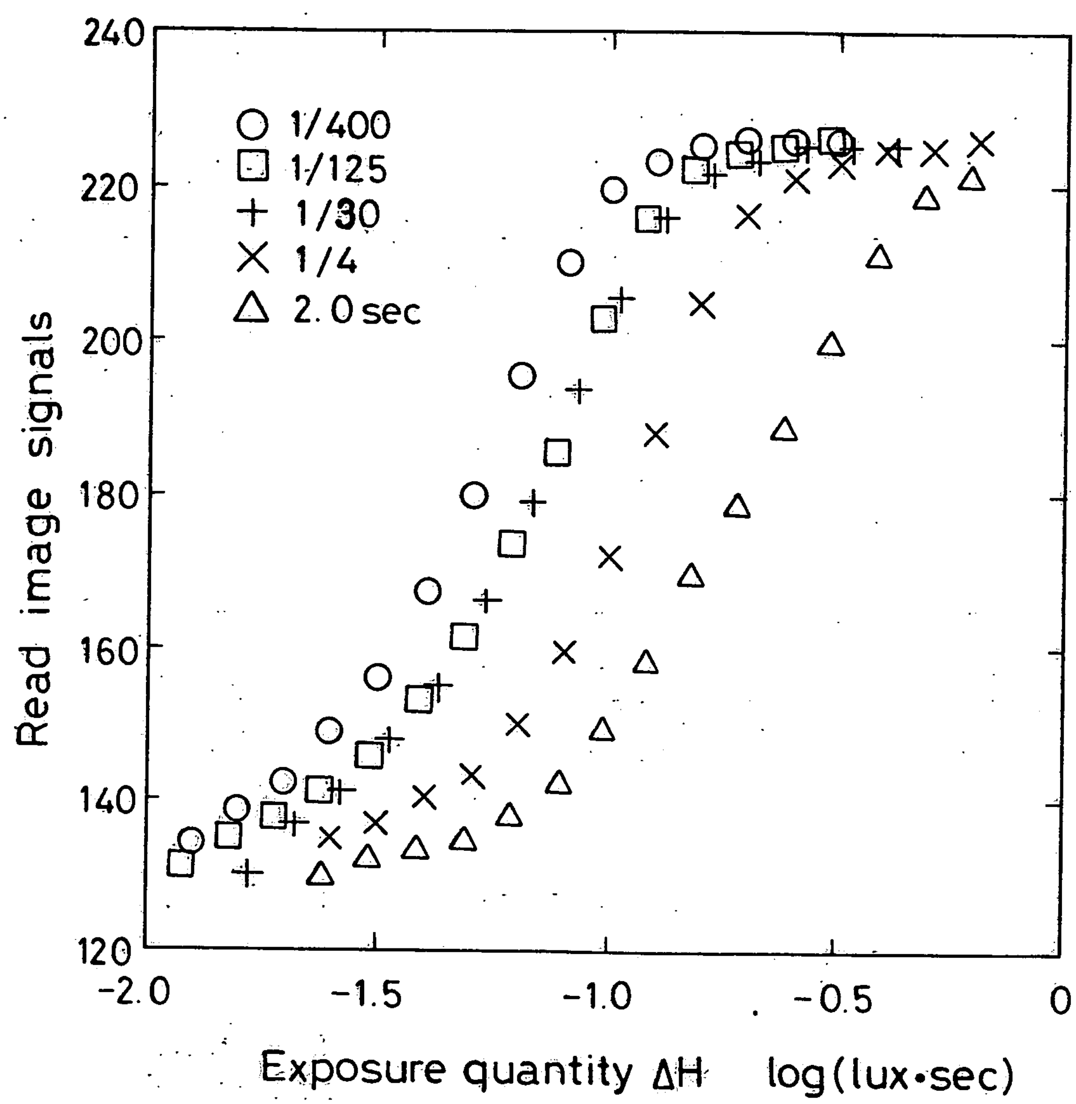
1.2
1.0
0.8
0.6
0.4
0.2
0
Current value (10^{-5}A/cm^2)
Base current
0
0.5
1
1.5
time (sec)

FIG. 29



Application of voltage
Exposure to image light

FIG. 30



1/400
1/125
1/30
1/4
2.0 sec
Read image signals
240
220
200
180
160
140
120
-2.0
-1.5
-1.0
-0.5
0
Exposure quantity ΔH log(lux•sec)

FIG. 31

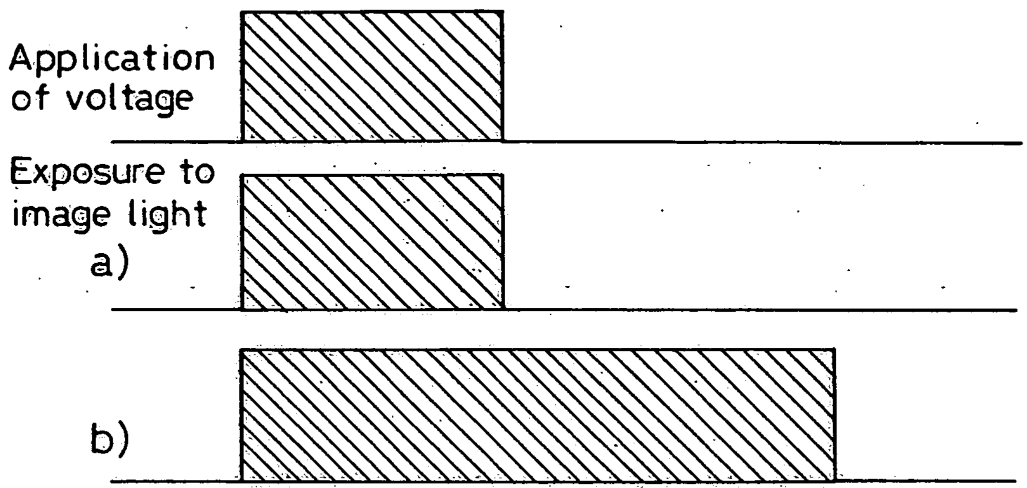

Application
of voltage
Exposure to
image light
a)
b)

FIG. 32

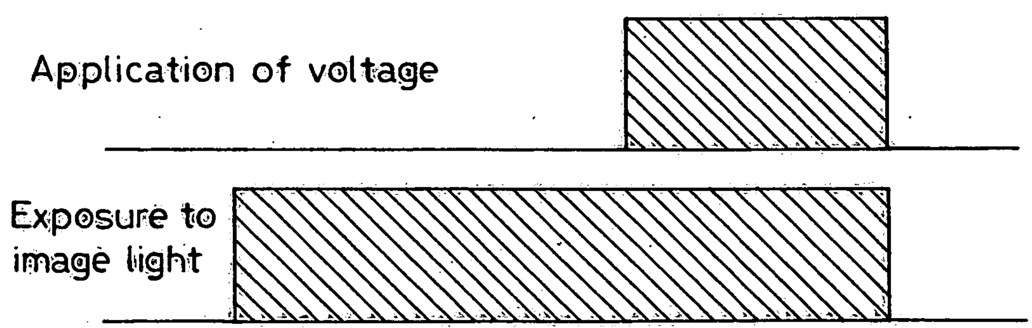

Application of voltage
Exposure to
image light

FIG. 33

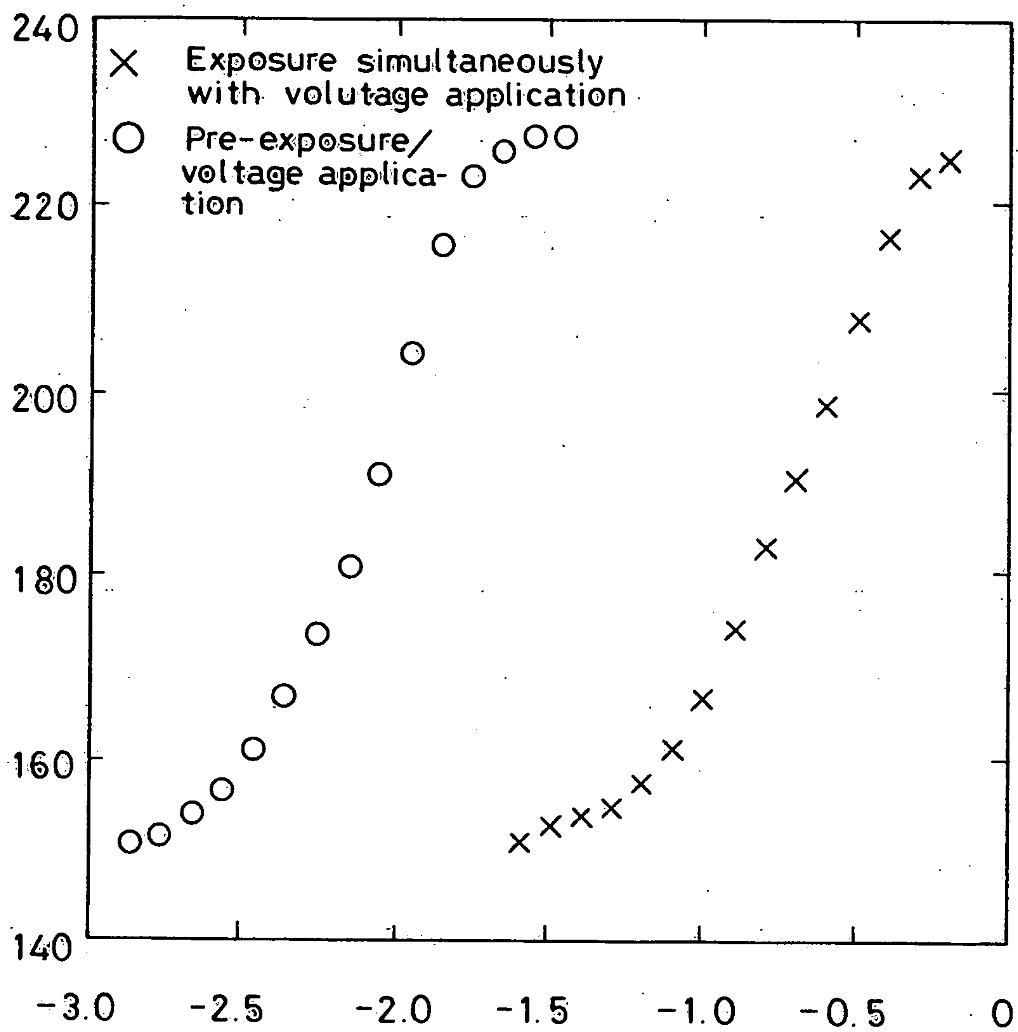
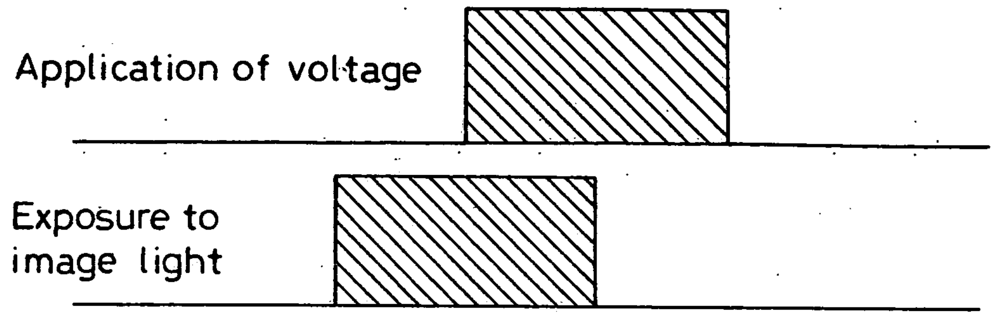
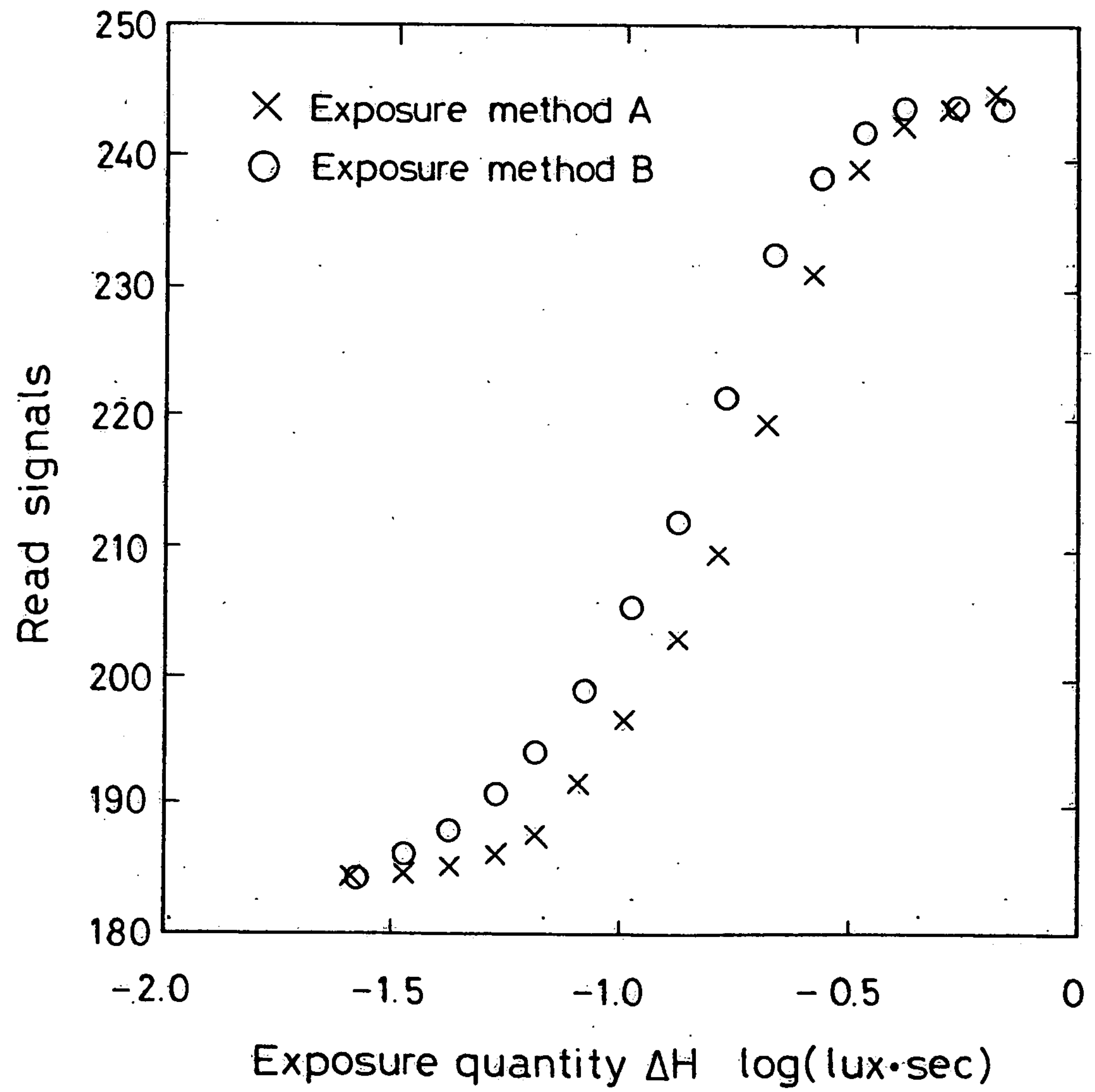

240
220
200
180
160
140
-3.0
-2.5
-2.0
-1.5
-1.0
-0.5
0
Exposure simultaneously with volutage application
Pre-exposure/ voltage applica- tion

FIG. 34



Application of voltage
Exposure to image light

FIG. 35



Exposure method A
Exposure method B
250
240
230
220
210
200
190
180
Read signals
-2.0
-1.5
-1.0
-0.5
0
Exposure quantity ΔH log(lux•sec)

FIG. 36

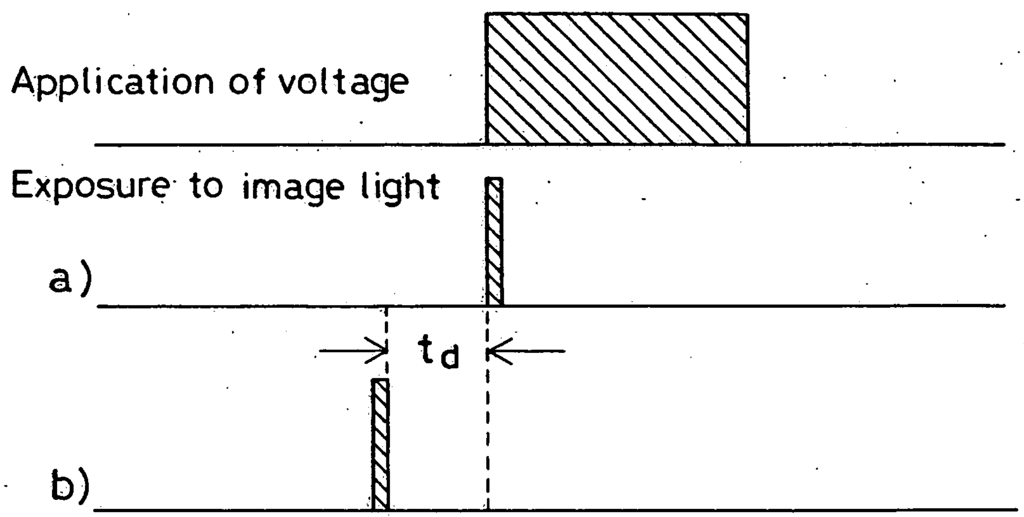


FIG. 37

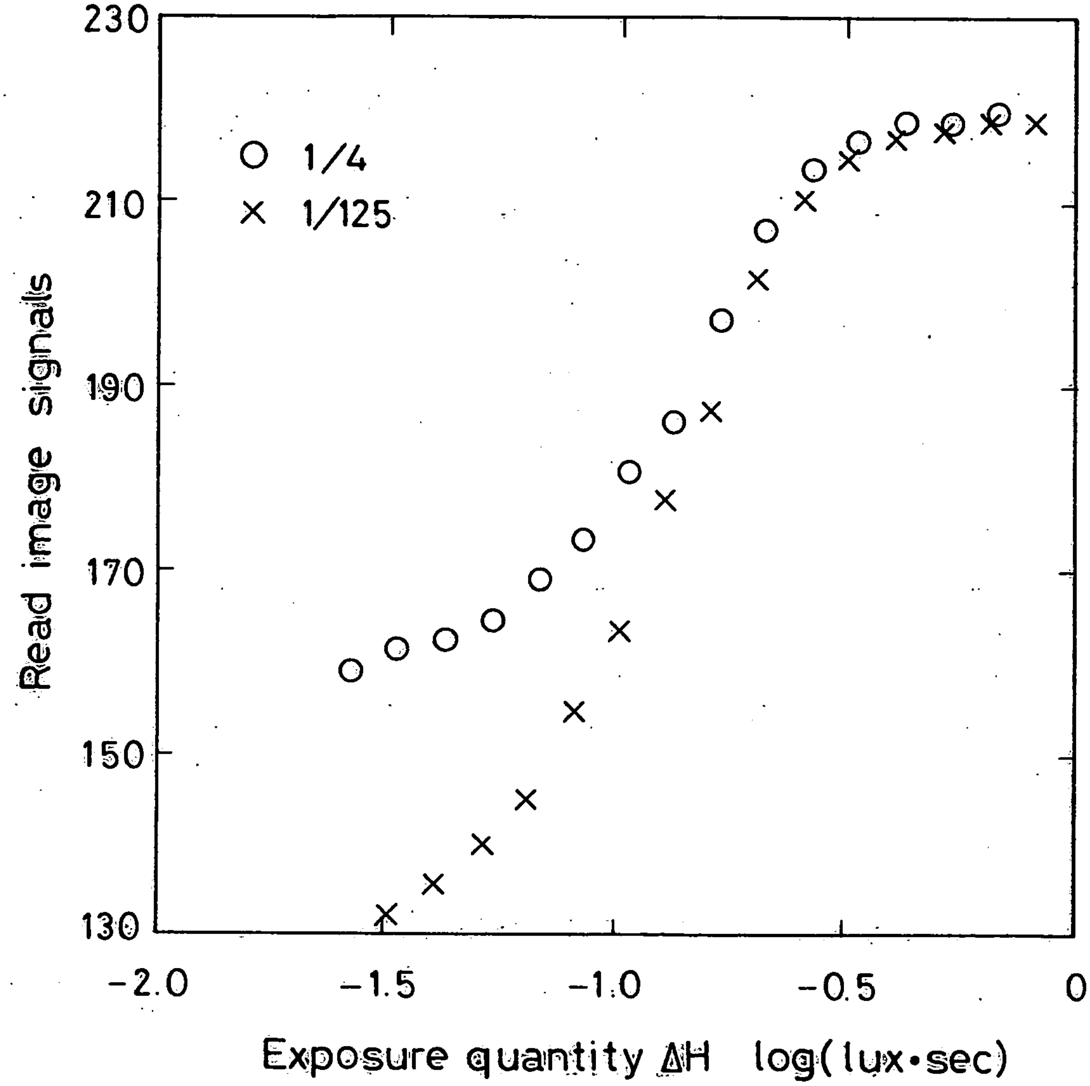
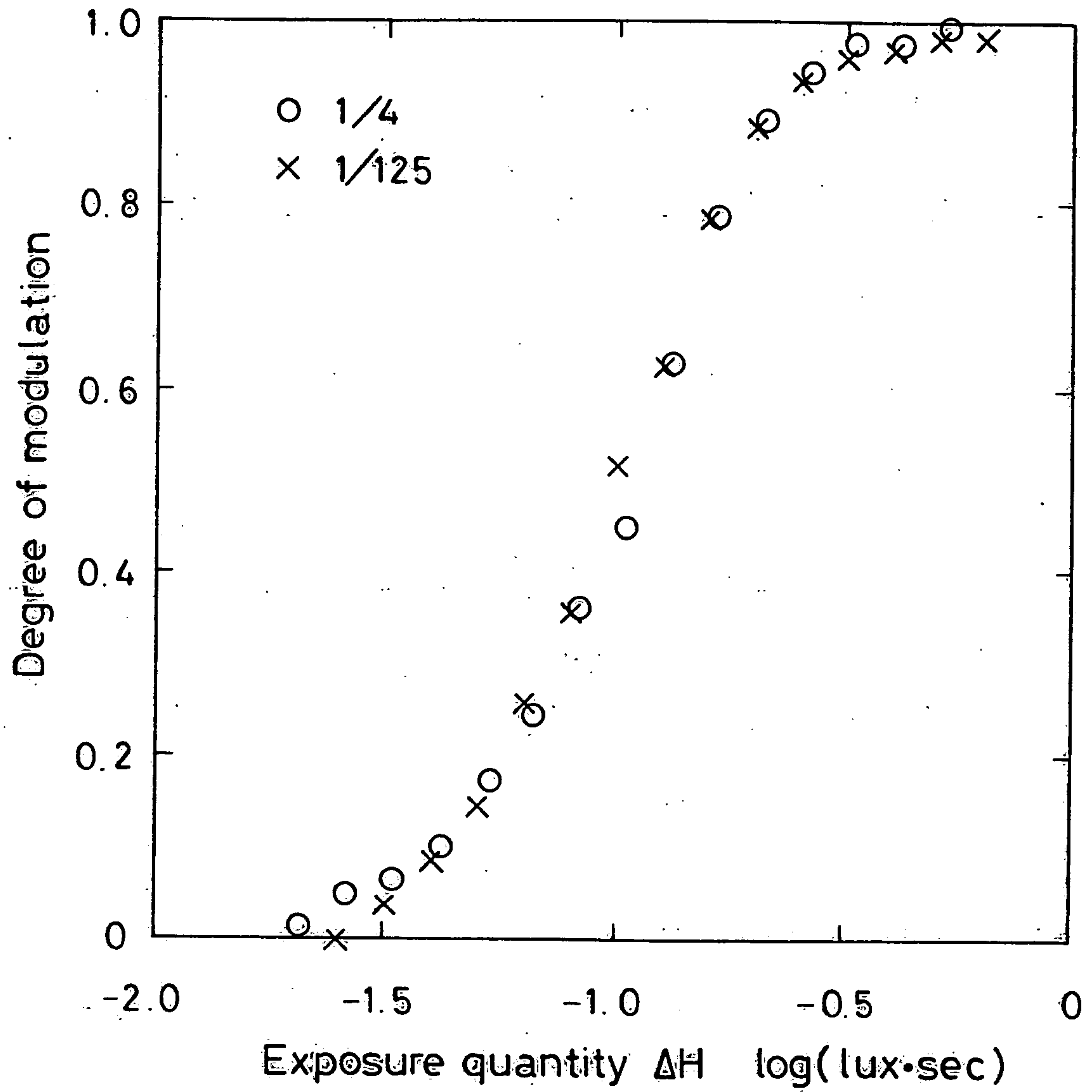
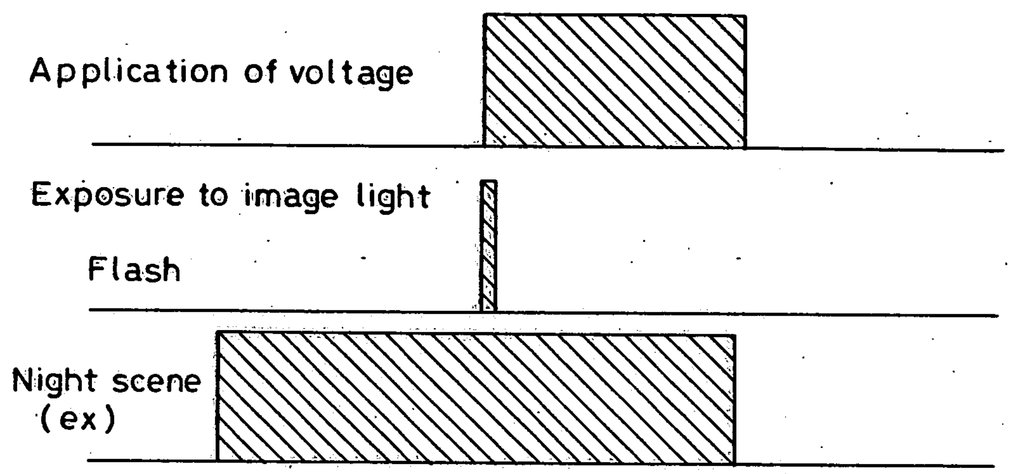

230
210
190
170
150
130
Read image signals
○ 1/4
× 1/125
-2.0
-1.5
-1.0
-0.5
0
Exposure quantity ΔH log(lux•sec)

FIG. 38



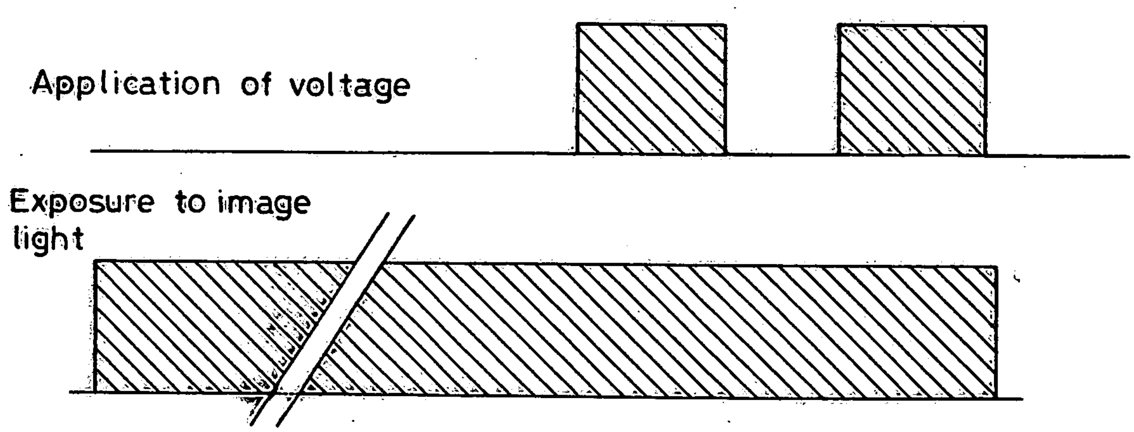
1.0
0.8
0.6
0.4
0.2
0
Degree of modulation
○ 1/4
× 1/125
-2.0
-1.5
-1.0
-0.5
0
Exposure quantity ΔH log(lux•sec)

FIG. 39



Application of voltage
Exposure to image light
Flash
Night scene
(ex)

FIG. 40



Application of voltage
Exposure to image
light

FIG. 41

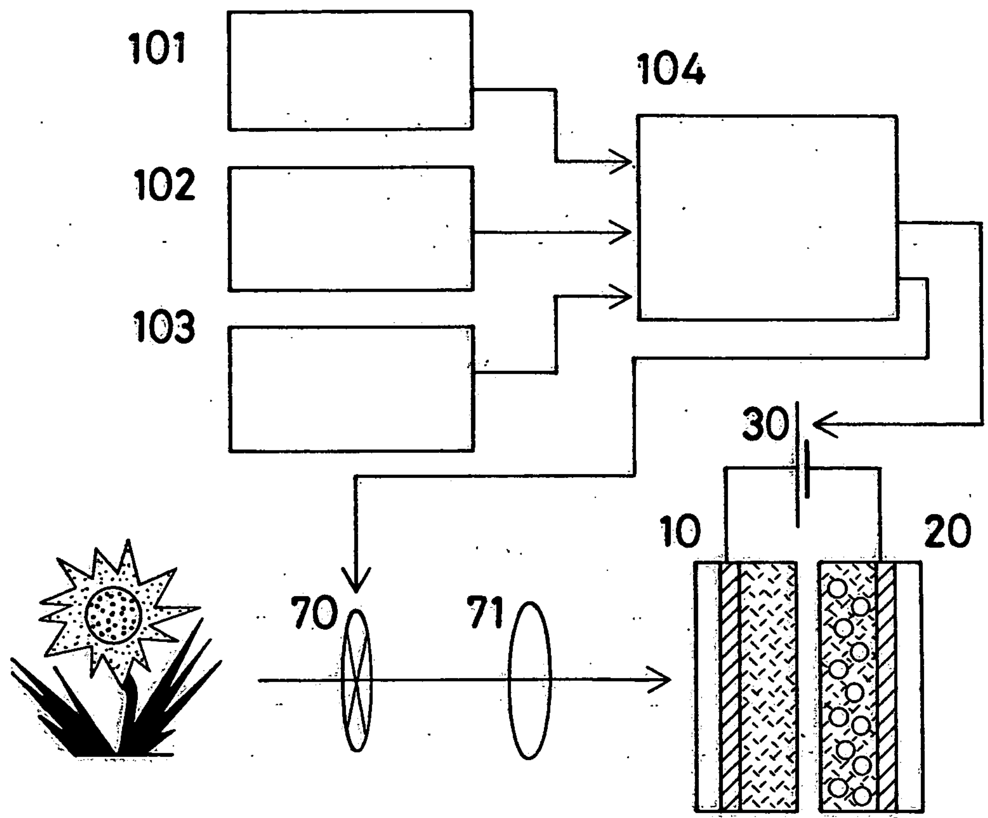


FIG. 42

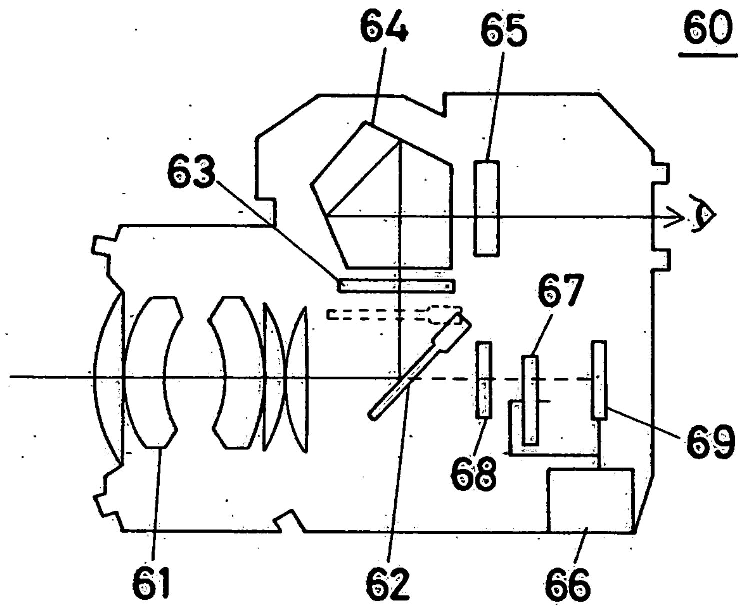

64
65
60
63
67
69
68
61
62
66

FIG. 43

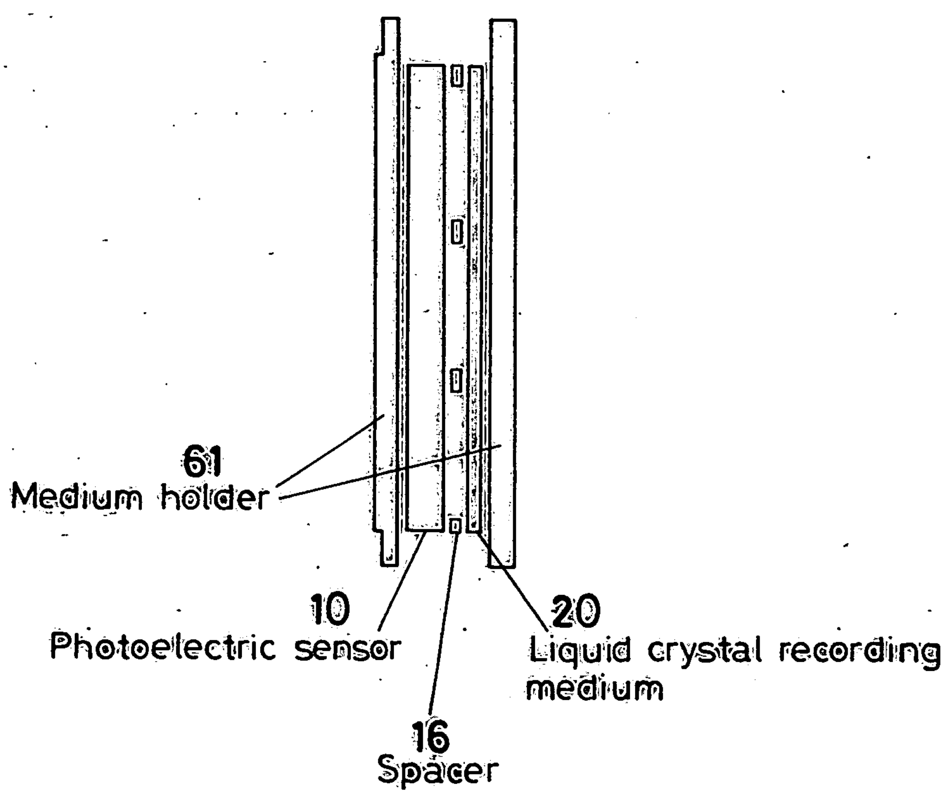

61
Medium holder
10
Photoelectric sensor
20
Liquid crystal recording medium
16
Spacer

FIG. 44

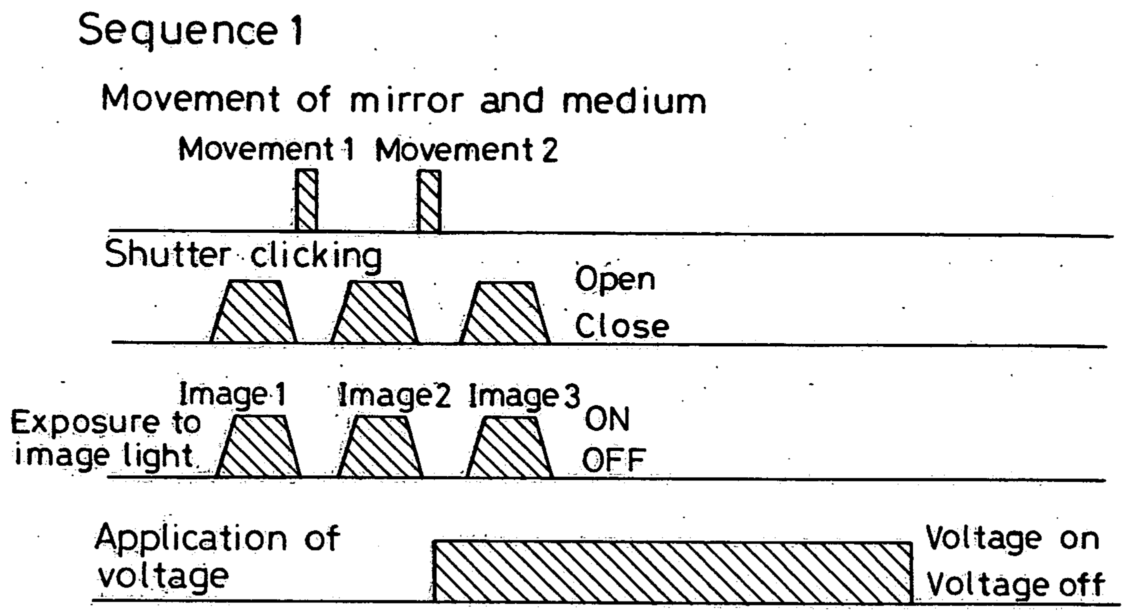

Sequence 1
Movement of mirror and medium
Movement 1
Movement 2
Shutter clicking
Open
Close
Image 1
Image2
Image 3
Exposure to image light
ON
OFF
Application of voltage
Voltage on
Voltage off

FIG. 45

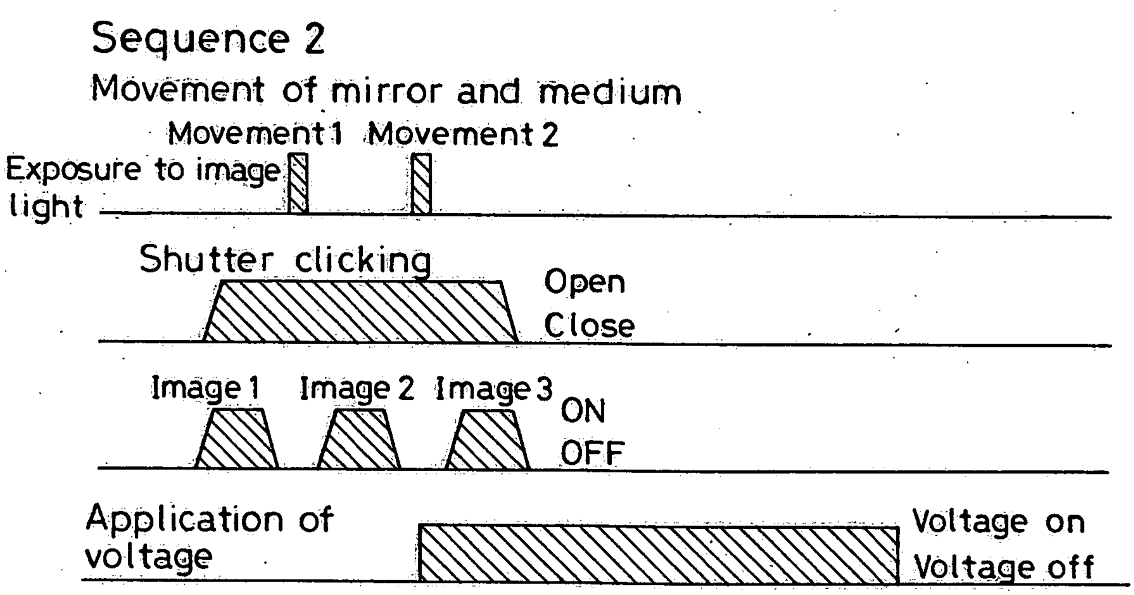
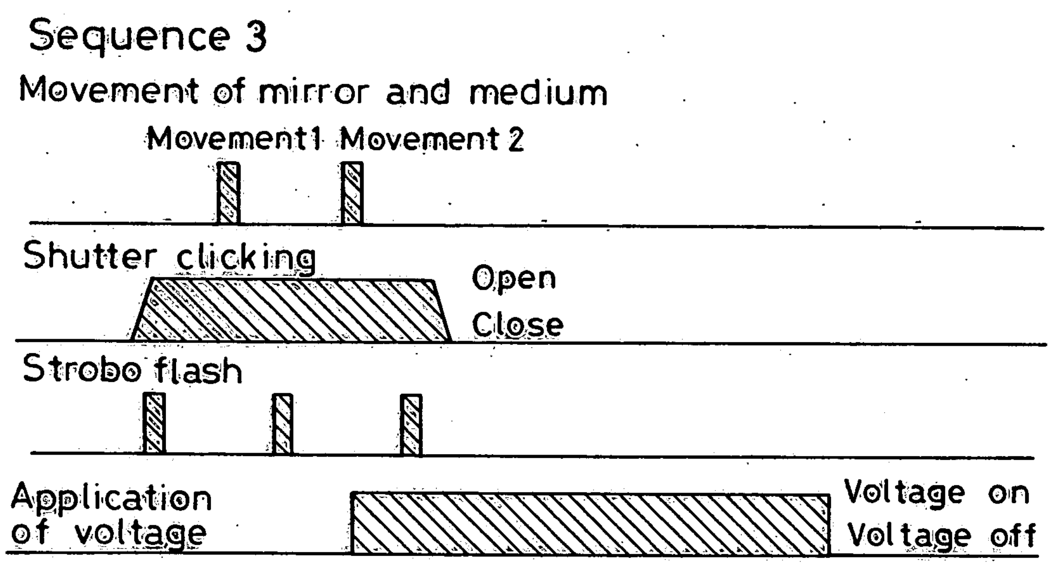

Sequence 2
Movement of mirror and medium
Movement 1
Movement 2
Exposure to image light
Shutter clicking
Open
Close
Image 1
Image 2
Image 3
ON
OFF
Application of voltage
Voltage on
Voltage off

FIG. 46



Sequence 3
Movement of mirror and medium
Movement1
Movement 2
Shutter clicking
Open
Close
Strobo flash
Application of voltage
Voltage on
Voltage off

PATENT

Docket No. 2122-4028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	:	Masato Okabe	Group Art Unit: TBA
Serial No.	:	08/428,325	Examiner: TBA
Filing Date	:	April 25, 1995	
For	:	PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD, AND INFORMATION RECORDING SYSTEM	

PETITION AND FEE FOR EXTENSION OF TIME (37 C.F.R. §1.136(a))

ASSISTANT COMMISSIONER OF PATENTS
Washington, D.C. 20231

Sir:

1. This is a petition for an extension of time for filing Response to Notice to File Missing Parts.

2. The communication in connection with the matter for which this extension is requested

   [X] is filed herewith.

   [ ] has been filed on ______________________.

3. [ ] Applicant is a small-entity -- verified statement is attached [ ], or has already been filed. [ ].

4.

		Total Months Requested	Fee for Other than Small Entity	Fee for Small Entity
a.	[ ]	one month	$110.00	$55.00
b.	[X]	two months	$370.00	$185.00
c.	[ ]	three months	$870.00	$435.00
d.	[ ]	four months	$1,360.00	$680.00

e. [ ] An extension for ____ months has already been secured for filing the above-identified communication and the fee paid therefor of $ _______ is deducted from the total fee due for the total months of extension now requested. The fee for this extension ($ _______), minus the fee previously paid ($ _______) equals $ ________ (total fee due).

5. [X] A check in the amount of $ 370.00 to cover the extension fee is attached.

6. [ ] Charge fee to Deposit Account No. 13-4500. Order No. ______________. A DUPLICATE COPY OF THIS SHEET IS ATTACHED.

7. [X] The Commissioner is hereby authorized to charge any additional fees which may be required by this paper, or credit any overpayment to Deposit Account No. 13-4500. Order No. 2122-4028. A DUPLICATE COPY OF THIS SHEET IS ATTACHED.

Respectfully submitted,

MORGAN & FINNEGAN, L.L.P.

Dated: August 16, 1995

By: Bruce D. DeRenzi

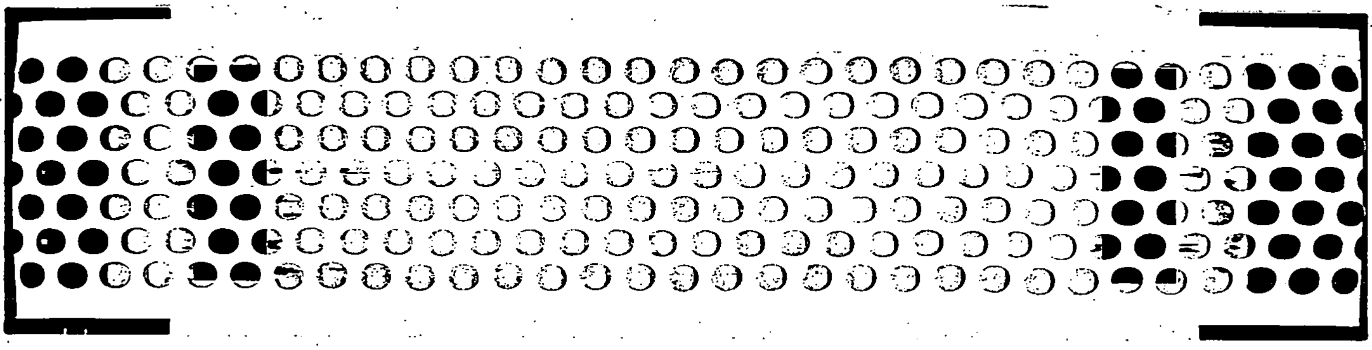
Bruce D. DeRenzi
Registration No. 33,676

Mailing Address:

MORGAN & FINNEGAN, L.L.P.
345 Park Avenue
New York, New York 10154
(212) 758-4800
(212) 751-6849 Telecopier

FORM: PET-XOT.NY
Rev. 3/27/95

*



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NEW YORK, NY 10154

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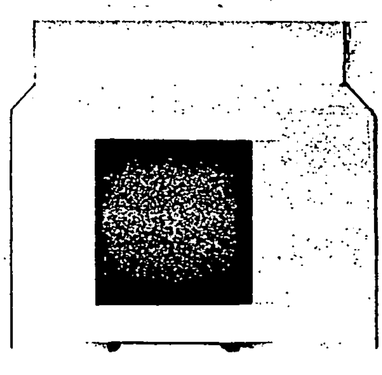

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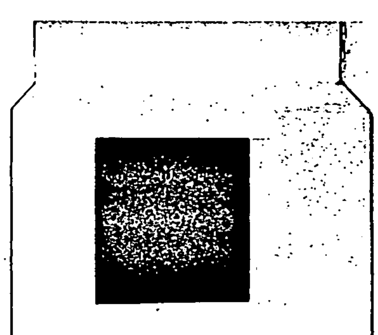

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

APPLICATION NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
08/428,325	04/25/95	OKABE	M 2122-4028

0212/0518

MORGAN AND FINNEGAN
345 PARK AVENUE
NEW YORK NY 10154

DATE MAILED: 0000

05/18/95

NOTICE TO FILE MISSING PARTS OF APPLICATION
FILING DATE GRANTED

An Application Number and Filing Date have been assigned to this application. However, the items indicated below are missing. The required items and fees identified below must be timely submitted **ALONG WITH THE PAYMENT OF A SURCHARGE** for items 1 and 3-6 only of $ 130 for large entities or $ 65 for small entities who have filed a verified statement claiming such status. The surcharge is set forth in 37 CFR 1.16(e).

If all required items on this form are filed within the period set below, the total amount owed by applian as a ☑ large entity, ☐ small entity (verified statement filed), is $ 260.

Applicant is given **ONE MONTH FROM THE DATE OF THIS LETTER, OR TWO MONTHS FROM THE FILING DATE** of this application, **WHICHEVER IS LATER**, within which to file all required items and pay any fees required above to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

1. ☐ The statutory basic filing fee is: ☐ missing ☐ insufficient. Applicant as a ☐ large entity ☐ small entity, must submit $________ to complete the basic filing fee.

2. ☐ Additional claim fees of $________ as a ☐ large entity, ☐ small entity, including any required multiple dependent claim fee, are required. Applicant must submit the additional claim fees or cancel the additional claims for which fees are due.

3. ☑ The oath or declaration:
   ☑ is missing.
   ☐ does not cover the newly submitted items.

   An oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date is required.

4. ☐ The oath or declaration does not identify the application to which it applies. An oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.

5. ☐ The signature(s) to the oath or declaration is/are: ☐ missing; ☐ by a person other than the inventor or a person qualified under 37 CFR 1.42, 1.43, or 1.47. A properly signed oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.

6. ☐ The signature of the following joint inventor(s) is missing from the oath or declaration:

   __________ An oath or declaration listing the names of all inventors and signed by the omitted inventor(s), identifying this application by the above Application Number and Filing Date, is required.

7. ☑ The application was filed in a language other than English. Applicant must file a verified English translation of the application and a fee of $ 130 under 37 CFR 1.17(k), unless this fee has already been paid.

8. ☐ A $________ processing fee is required since your check was returned without payment. (37 CFR 1.21(m)).

9. ☐ Your filing receipt was mailed in error because your check was returned without payment.

10. ☐ The application does not comply with the Sequence Rules. See attached Notice to Comply with Sequence Rules 37 CFR 1.821-1.825.

11. ☐ Other.

Direct the response to Box Missing Part and refer any questions to the Customer Service Center at (703) 308-1202.

A copy of this notice MUST be returned with the response.

Case No. 2122-4028 **Serial No.** 08/428,325

Date Mailed August 16, 1995 **ATTY** BDD

Date Due in the Patent Office ____________

The return of this post card, properly stamped, will acknowledge receipt in the Patent & Trademark Office of the following:

1.- Response to Notice to File Missing Parts;
2.- Original signed Declaration;
3.- Original signed Verification with copy of English translation of application;
4.- Petition for Extension of Time (2 months);
5.- Checks in the amount of $370 (Extension of Time) and $260 (Response to Notice to File Missing Parts;
6.- Return postcard
Certificate of mailing

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Case No. 2122-4028 Serial No. 08/428,325

Date Mailed August 16, 1995 ATTY BDD

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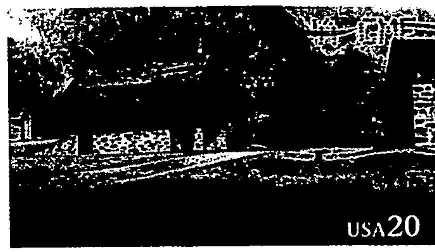

MORGAN & FINNEGAN, L.L.P.

345 PARK AVENUE

NEW YORK, NEW YORK 10154-0053

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PATENT

Docket No. 2122-4028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	:	Masato Okabe	Group Art Unit: TBA
Serial No.	:	08/428,325	Examiner: TBA
Filing Date	:	April 25, 1995	
For	:	PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD, AND INFORMATION RECORDING SYSTEM	

CERTIFICATE OF MAILING (37 C.F.R. §1.8a)

ASSISTANT COMMISSIONER OF PATENTS
BOX MISSING PARTS
Washington, D.C. 20231

I hereby certify that the attached:

1. Response to Notice to File Missing Parts;
2. Original signed Declaration;
3. Original signed Verification with copy of English translation of application;
4. Petition for Extension of Time (2 months);
5. Checks in the amount of \$370 (Extension of Time) and \$260 (Response to Notice to File Missing Parts);
6. Return postcard

(along with any paper(s) referred to as being attached or enclosed) and this Certificate of Mailing are being deposited with the United States Postal Service on the date shown below with sufficient postage as first-class mail in an envelope addressed to the: Assistant Commissioner of Patents, Washington, D.C. 20231.

Respectfully submitted,

MORGAN & FINNEGAN, L.L.P.

Date: August 16, 1995

By: Bruce D. DeRenzi
Bruce D. DeRenzi
Reg. No. 33,676

Mailing Address:

MORGAN & FINNEGAN, L.L.P.
345 Park Avenue
New York, New York 10154
(212) 758-4800 Telephone
(212) 758-6849 Facsimile

Rev. 121991 M&F

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CORRESPONDENCE #4

Docket No. 2122-4028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s) : Masato Okabe

Serial No. : 08/428,325 Group Art Unit: TBA

Filed : April 25, 1995 Examiner: TBA

For : PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD, AND INFORMATION RECORDING SYSTEM

RECORDATION FORM COVER SHEET PURSUANT TO 37 C.F.R. § 1.331

Assistant Commissioner Of Patents
BOX ASSIGNMENTS
Washington, D.C. 20231

Sir:

Please record the attached original documents or copy thereof.

1. Name of conveying party/parties:
Masato Okabe

2. Name and address of receiving party/parties:

Name: Dai Nippon Printing Co., Ltd.

Internal Address: ________

Street Address: 1-1 Ichigaya-Kagacho 1-chome, Shinjuku-ku

City Tokyo, 162 State JAPAN ZIP ________

Name: ________

Internal Address: ________

Street Address: ________

City ________ State ________ ZIP ________

[ ] Additional names and addresses attached.

3. Nature of Conveyance: [X] Assignment [ ] Merger [ ] Security Agreement
[ ] Change of Name [ ] Other ________
Execution Date: June 2, 1995

Docket No. 2122-4028

4. Application Number(s) or Patent Number(s):

[ ] This document is being filed together with a new application which was executed on ___________

[X] Patent Application No.(s) 08/428,325

[ ] Patent No.(s) ___________

5. Address all future communications to:

MORGAN & FINNEGAN, L.L.P.
345 Park Avenue
New York, New York 10154

6. Total number of applications and patents involved: one

7. Total fee (37 CFR § 1.331): $40.00 per property x 1 property(ies) = $ 40.00

[X] A check in the amount of $ 40.00 to cover the recordation fee is enclosed:

[ ] Charge fee to Deposit Account No. 13-4500. Order No. __________. A DUPLICATE COPY OF THIS SHEET IS ATTACHED.

[X] The Commissioner is hereby authorized to charged any additional fees which may be required for this recordation, or credit any overpayment to Deposit Account No. 13-4500. Order No. 2122-4028. A DUPLICATE COPY OF THIS SHEET IS ATTACHED.

8. To the best of my knowledge and belief, the foregoing information is true and correct and any attached copy is a true copy of the original document.

Respectfully submitted,

MORGAN & FINNEGAN, L.L.P.

Dated: August 21, 1995

By: Bruce D. DeRenzi
Bruce D. DeRenzi
Registration No. 33,676

Mailing Address:

Total number of pages comprising this cover sheet 2

MORGAN & FINNEGAN, L.L.P.
345 Park Avenue
New York, New York 10154
(212) 758-4800
(212) 751-6849 Telecopier

FORM: REC-PAT.NY
Rev. 3/27/95

SOLE PATENT
L.CKET NO. 2122-4028

ASSIGNMENT

TO ALL WHOM IT MAY CONCERN, be it known that:

WHEREAS I/we, the undersigned Masato OKABE citizen of Japan residing at 1-1 Ichigaya-Kagacho 1-chome, Shinjuku-ku, Tokyo, 162 JAPAN hereinafter referred to as "Assignor", has made an invention or discovery in

PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD, AND INFORMATION RECORDING SYSTEM

which is fully described and set forth in an application for Letters Patent of the United States of America, executed by me concurrently herewith; and

WHEREAS, **DAI NIPPON PRINTING CO., LTD.**, a corporation of **Japan** having a place of business at 1-1 Ichigaya-Kagacho 1-chome, Shinjuku-ku, Tokyo, 162 JAPAN, hereinafter referred to as "Assignee", is desirous of obtaining the full and entire right, title and interest, for the territory of the United States of America, in, to and under said application and any Letters Patent of the United States of America to be issued thereon;

NOW, THEREFORE, for and in consideration of the sum of One Dollar ($1.00), and other good and valuable consideration, the receipt of which is hereby acknowledged, the Assignor has sold, assigned, transferred and set over, and by these presents does hereby sell, assign, transfer and set over to Assignee, its successors, legal representatives and assigns, the full and entire right, title and interest, for the territory of the United States of America and not elsewhere, in, to and under the application for Letters Patent of the United States of America, any refiling, division or continuation of said application, each Letters Patent of the United States of America which may issue from said application and any reissue or extension thereof, and the invention described in said application;

Assignor hereby covenants and agrees that it will at any time upon the request and at the expense of Assignee execute and deliver any and all papers and do all lawful acts that may be necessary or desirable to perfect the title to said invention and to obtain a Letters Patent therefor, and the Assignor hereby authorizes and requests the Commissioner of Patents and Trademarks of the United States of America, to issue Letters Patent of the United States of America from said application to Assignee as the Assignee of the entire right, title and interest in, to and under the same, for the sole use and behoof of Assignee, its successors, legal representatives and assigns, in accordance with the terms of this Assignment.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my seal this 2nd day of June, 1995.

Masato Okabe
Masato Okabe

Witnesseth:

Yoshihilo Fukui
Yoshihilo FUKUI

150956_1

MORGAN & FINNEGAN, L.L.P.
ATTORNEYS AT LAW
345 PARK AVE.
NEW YORK, NY 10154

4374

August 15 1995

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SORT NO. 2411
NEW YORK, N.Y. 10043

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OR 2122-4028

John C. Vassil

[redacted]

Case No. 2122-4028 Serial No. 08/428,325

Date Mailed August 21, 1995 ATTY BDD

Date Due in the Patent Office ____________

The return of this post card, properly stamped, will acknowledge receipt in the Patent & Trademark Office of the following:

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B-DeRenzi

Case No. 2122-4028 Serial No. 08/428,325

Date Mailed August 21, 1995 ATTY BDD

Date Due in the Patent Office ____________

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B-DeRenzi

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1995

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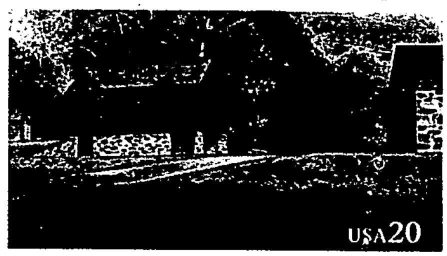
MORGAN & FINNEGAN



MORGAN & FINNEGAN, L.L.P.

345 PARK AVENUE

NEW YORK, NEW YORK 10154-0053

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PATENT Docket No. 2122-4028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	:	Masato Okabe	Group Art Unit: TBA
Serial No.	:	08/428,325	Examiner: TBA
Filing Date	:	April 25, 1995	
For	:	PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD, AND INFORMATION RECORDING SYSTEM	

CERTIFICATE OF MAILING (37 C.F.R. §1.8a)

ASSISTANT COMMISSIONER OF PATENTS
BOX ASSIGNMENT
Washington, D.C. 20231

I hereby certify that the attached:

1. Recordation Form Cover Sheet;
2. Executed Assignment;
3. Check in the amount of $40.00; and
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(along with any paper(s) referred to as being attached or enclosed) and this Certificate of Mailing are being deposited with the United States Postal Service on the date shown below with sufficient postage as first-class mail in an envelope addressed to the: Assistant Commissioner of Patents, Washington, D.C. 20231.

Respectfully submitted,

MORGAN & FINNEGAN, L.L.P.

Date: August 21, 1995

By: Bruce D. DeRenzi
Bruce D. DeRenzi
Reg. No. 33,676

Mailing Address:

MORGAN & FINNEGAN, L.L.P.
345 Park Avenue
New York, New York 10154
(212) 758-4800 Telephone
(212) 758-6849 Facsimile

Rev. 121991 M&F

172479_1

CORRESPONDENCE #5

C. E. Chalsen, Jr.

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
ASSISTANT SECRETARY AND COMMISSIONER
OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

2122-4028

JANUARY 27, 1996

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FEB 05 1996

MORGAN & FINNEGAN

100069529A

MORGAN & FINNEGAN, L.L.P.
BRUCE D. DERENZI
345 PARK AVENUE
NEW YORK, NY 10154

UNITED STATES PATENT AND TRADEMARK OFFICE
NOTICE OF RECORDATION OF ASSIGNMENT DOCUMENT

THE ENCLOSED DOCUMENT HAS BEEN RECORDED BY THE ASSIGNMENT DIVISION OF THE U.S. PATENT AND TRADEMARK OFFICE. A COMPLETE MICROFILM COPY IS AVAILABLE AT THE ASSIGNMENT SEARCH ROOM ON THE REEL AND FRAME NUMBER REFERENCED BELOW.

PLEASE REVIEW ALL INFORMATION CONTAINED ON THIS NOTICE. THE INFORMATION CONTAINED ON THIS RECORDATION NOTICE REFLECTS THE DATA PRESENT IN THE PATENT AND TRADEMARK ASSIGNMENT SYSTEM. IF YOU SHOULD FIND ANY ERRORS OR HAVE QUESTIONS CONCERNING THIS NOTICE, YOU MAY CONTACT THE EMPLOYEE WHOSE NAME APPEARS ON THIS NOTICE AT 703-308-9723. PLEASE SEND REQUEST FOR CORRECTION TO: U.S. PATENT AND TRADEMARK OFFICE, ASSIGNMENT DIVISION, BOX ASSIGNMENTS, NORTH TOWER BUILDING, SUITE 10C35, WASHINGTON, D.C. 20231.

RECORDATION DATE: 08/24/1995

REEL/FRAME: 7630/0063
NUMBER OF PAGES: 3

BRIEF: ASSIGNMENT OF ASSIGNOR'S INTEREST (SEE DOCUMENT FOR DETAILS).

ASSIGNOR:
OKABE, MASATO

DOC DATE: 06/02/1995

ASSIGNEE:
DAI NIPPON PRINTING CO., LTD.
1-1 ICHIGAYA-KAGACHO 1-CHOME, SHINJUKU-KU
TOKYO, 162, JAPAN

SERIAL NUMBER: 08428325
PATENT NUMBER:

FILING DATE: 04/25/1995
ISSUE DATE:

REGINA COATES, EXAMINER
ASSIGNMENT DIVISION
OFFICE OF PUBLIC RECORDS

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09-27-1995

Docket No. 2122-4028

AUG 24 1995 14 MAIL ROOM PAT. & TRADEMARK OFF.

IN THE UNITE[D STATES PATENT AND TRADEMAR]K OFFICE

100069529

Applicant : Masato Okabe

Serial No. : 08/428,325 Group Art Unit: TBA

Filed : April 25, 1995 Examiner: TBA

MRD 8-24-95

For : PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD, AND INFORMATION RECORDING SYSTEM

RECORDATION FORM COVER SHEET PURSUANT TO 37 C.F.R. § 1.331

Assistant Commissioner Of Patents
BOX ASSIGNMENTS
Washington, D.C. 20231

Sir:

Please record the attached original documents or copy thereof.

1. Name of conveying party/parties:
Masato Okabe

2. Name and address of receiving party/parties:

Name: Dai Nippon Printing Co., Ltd.

Internal Address:

Street Address: 1-1 Ichigaya-Kagacho 1-chome, Shinjuku-ku

City Tokyo, 162 State JAPAN ZIP

Name:

Internal Address:

Street Address:

City 050 MH 09/07/95 08428325 State 1 581 40.00 ZIP CK

[ ] Additional names and addresses attached.

3. Nature of Conveyance: [X] Assignment [ ] Merger [ ] Security Agreement
[ ] Change of Name [ ] Other
Execution Date: June 2, 1995

4. Application Number(s) or Patent Number(s):

[ ] This document is being filed together with a new application which was executed on ____________

[X] Patent Application No.(s) 08/428,325

[ ] Patent No.(s) ____________

5. Address all future communications to:

MORGAN & FINNEGAN, L.L.P.
345 Park Avenue
New York, New York 10154

6. Total number of applications and patents involved: one

7. Total fee (37 CFR § 1.331): $40.00 per property x 1 property(ies) = $ 40.00

[X] A check in the amount of $ 40.00 to cover the recordation fee is enclosed:

[ ] Charge fee to Deposit Account No. 13-4500. Order No. __________. A DUPLICATE COPY OF THIS SHEET IS ATTACHED.

[X] The Commissioner is hereby authorized to charged any additional fees which may be required for this recordation, or credit any overpayment to Deposit Account No. 13-4500. Order No. 2122-4028. A DUPLICATE COPY OF THIS SHEET IS ATTACHED.

8. To the best of my knowledge and belief, the foregoing information is true and correct and any attached copy is a true copy of the original document.

Respectfully submitted,

MORGAN & FINNEGAN, L.L.P.

Dated: August 21, 1995

By: Bruce D. DeRenzi
Bruce D. DeRenzi
Registration No. 33,676

Mailing Address:

MORGAN & FINNEGAN, L.L.P.
345 Park Avenue
New York, New York 10154
(212) 758-4800
(212) 751-6849 Telecopier

Total number of pages comprising this cover sheet 2

FORM: REC-PAT.NY
Rev. 3/27/95

172484_1

SOLE PATENT
DOCKET NO. 2122-4028

ASSIGNMENT

TO ALL WHOM IT MAY CONCERN, be it known that:

WHEREAS I/we, the undersigned Masato OKABE citizen of Japan residing at 1-1 Ichigaya-Kagacho 1-chome, Shinjuku-ku, Tokyo, 162 JAPAN hereinafter referred to as "Assignor", has made an invention or discovery in

PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD, AND INFORMATION RECORDING SYSTEM

which is fully described and set forth in an application for Letters Patent of the United States of America, executed by me concurrently herewith; and

WHEREAS, **DAI NIPPON PRINTING CO., LTD.**, a corporation of Japan having a place of business at 1-1 Ichigaya-Kagacho 1-chome, Shinjuku-ku, Tokyo, 162 JAPAN, hereinafter referred to as "Assignee", is desirous of obtaining the full and entire right, title and interest, for the territory of the United States of America, in, to and under said application and any Letters Patent of the United States of America to be issued thereon;

NOW, THEREFORE, for and in consideration of the sum of One Dollar ($1.00), and other good and valuable consideration, the receipt of which is hereby acknowledged, the Assignor has sold, assigned, transferred and set over, and by these presents does hereby sell, assign, transfer and set over to Assignee, its successors, legal representatives and assigns, the full and entire right, title and interest, for the territory of the United States of America and not elsewhere, in, to and under the application for Letters Patent of the United States of America, any refiling, division or continuation of said application, each Letters Patent of the United States of America which may issue from said application and any reissue or extension thereof, and the invention described in said application;

Assignor hereby covenants and agrees that it will at any time upon the request and at the expense of Assignee execute and deliver any and all papers and do all lawful acts that may be necessary or desirable to perfect the title to said invention and to obtain a Letters Patent therefor, and the Assignor hereby authorizes and requests the Commissioner of Patents and Trademarks of the United States of America, to issue Letters Patent of the United States of America from said application to Assignee as the Assignee of the entire right, title and interest in, to and under the same, for the sole use and behoof of Assignee, its successors, legal representatives and assigns, in accordance with the terms of this Assignment.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my seal this 2nd day of June, 1995.

Masato Okabe
Masato Okabe

Witnesseth:

Yoshihilo Fukui
Yoshihilo FUKUI

150956_1

PATENT MAIL ROOM AUG 24 1995 PAT. & TRADEMARK OFF. 14

Docket No. 2122-4028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	:	Masato Okabe	Group Art Unit: TBA
Serial No.	:	08/428,325	Examiner: TBA
Filing Date	:	April 25, 1995	
For	:	PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD, AND INFORMATION RECORDING SYSTEM	

CERTIFICATE OF MAILING (37 C.F.R. §1.8a)

ASSISTANT COMMISSIONER OF PATENTS
BOX ASSIGNMENT
Washington, D.C. 20231

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2. Executed Assignment;
3. Check in the amount of $40.00; and
4. Return postcard

(along with any paper(s) referred to as being attached or enclosed) and this Certificate of Mailing are being deposited with the United States Postal Service on the date shown below with sufficient postage as first-class mail in an envelope addressed to the: Assistant Commissioner of Patents, Washington, D.C. 20231.

Respectfully submitted,

MORGAN & FINNEGAN, L.L.P.

Date: August 21, 1995

By: Bruce D. DeRenzi
Bruce D. DeRenzi
Reg. No. 33,676

Mailing Address:

MORGAN & FINNEGAN, L.L.P.
345 Park Avenue
New York, New York 10154
(212) 758-4800 Telephone
(212) 758-6849 Facsimile

Rev. 121991 M&F

172479_1

Docket No. 2122-4028

4. Application Number(s) or Patent Number(s):

[ ] This document is being filed together with a new application which was executed on ______

[X] Patent Application No.(s) 08/428,325

[ ] Patent No.(s) ______

5. Address all future communications to:

MORGAN & FINNEGAN, L.L.P.
345 Park Avenue
New York, New York 10154

6. Total number of applications and patents involved: one

7. Total fee (37 CFR § 1.331): $40.00 per property x 1 property(ies) = $ 40.00

[X] A check in the amount of $ 40.00 to cover the recordation fee is enclosed:

[ ] Charge fee to Deposit Account No. 13-4500. Order No. ______. A DUPLICATE COPY OF THIS SHEET IS ATTACHED.

[X] The Commissioner is hereby authorized to charged any additional fees which may be required for this recordation, or credit any overpayment to Deposit Account No. 13-4500. Order No. 2122-4028. A DUPLICATE COPY OF THIS SHEET IS ATTACHED.

8. To the best of my knowledge and belief, the foregoing information is true and correct and any attached copy is a true copy of the original document.

Respectfully submitted,

MORGAN & FINNEGAN, L.L.P.

Dated: August 21, 1995

By: Bruce D. DeRenzi
Bruce D. DeRenzi
Registration No. 33,676

Mailing Address:

MORGAN & FINNEGAN, L.L.P.
345 Park Avenue
New York, New York 10154
(212) 758-4800
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Total number of pages comprising this cover sheet 2

FORM: REC-PAT.NY
Rev. 3/27/95

CORRESPONDENCE #6

DOCKET NO.: 2122-4028 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	:	Masato Okabe	Group	:	TBA
Serial No.	:	08/428,325	Examiner	:	TBA
Filed	:	April 25, 1995			
For	:	PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD, AND INFORMATION RECORDING SYSTEM			

INFORMATION DISCLOSURE STATEMENT
Under 37 CFR §§1.56 And 1.97

Assistant Commissioner For Patents
Washington, D.C. 20231

Sir:

This Information Disclosure Statement is filed in accordance with 37 C.F.R. §§1.56, 1.97 and 1.98. The items listed on Form PTO-1449, a copy of which is enclosed, may be deemed to be pertinent to the above-identified application and are made of record to assist the Patent and Trademark Office in its examination of this application. The Examiner is respectfully requested to fully consider the items and to independently ascertain their teaching.

1. [X] For each of the following items listed on the enclosed copy of Form PTO-1449 that is not in the English language, an English language translation of that item or a portion thereof or a concise explanation of the relevance of that item is enclosed:
(see attachment hereto) ______________________________
____
____

2. [ ] For each of the following items listed on the enclosed copy of Form PTO-1449 that is not in the English language, a concise explanation of the relevance of that item is incorporated in the specification of the above-identified application.

3. [ ] Any copy of the items listed on the enclosed copy of Form PTO-1449 that is not enclosed with this Information Disclosure Statement was previously cited by or submitted to the Patent and Trademark Office in the prior [ ] Continuation, [ ] Divisional or [ ] Continuation-In-Part application under 37 C.F.R. §1.60, U.S. Serial No. ______________________, filed ______ ______________.

200392 1

4. [X] No fee is due under 37 C.F.R. §1.17(p) for this Information Disclosure Statement since it is being filed in compliance with:

[ ] 37 C.F.R. §1.97(b)(1), within three months of the filing date of the above-identified application.

[ ] 37 C.F.R. §1.97(b)(2), within three months of the date of entry into the national stage as set forth in §1.491 in an international application.

[X] 37 C.F.R. §1.97(b)(3), before the mailing date of a first Office action on the merits.

5. [ ] No fee is due under 37 C.F.R. §1.17(p) for this Information Disclosure Statement since it is being filed in compliance with 37 C.F.R. §1.97(c), after the period specified in paragraph 4 above but before the mailing date of a final action or a Notice of Allowance (where there has been no prior final action), and is accompanied by one of the certifications pursuant to 37 C.F.R. §1.97(e) set forth in paragraph 9 below.

6. [ ] A fee is due under 37 C.F.R. §1.17(p) for this Information Disclosure Statement since it is being filed in compliance with 37 C.F.R. §1.97(c), after the period specified in paragraph 4 above but before the mailing date of a final action or a notice of allowance (where there has been no prior final action):

[ ] A check in the amount of $200.00 is enclosed in payment of the fee.

[ ] Charge the fee to Deposit Account No. 13-4500. Order No. ___________.
A DUPLICATE COPY OF THIS SHEET IS ATTACHED.

7. [ ] A fee is due under 37 C.F.R. §1.17(i)(1) for this Information Disclosure Statement since it is being filed in compliance with 37 C.F.R. §1.97(d), after the mailing date of a final action or a notice of allowance, whichever comes first, but before payment of the issue fee, and is accompanied by:

a. one of the certifications pursuant to 37 C.F.R. §1.97(e) set forth in paragraph 9 below; and

b. the attached petition requesting consideration of this Information Disclosure Statement; and

c. the fee due under 37 C.F.R. §1.17(i)(1) which is paid as set forth in paragraph 10 below.

8. [ ] A fee is due under 37 C.F.R. §1.17(i)(1) for this Information Disclosure Statement since it is being filed in compliance with:

a. [ ] 37 C.F.R. §1.313(b)(3), after the issue fee has been paid and information cited in this Information Disclosure Statement may render at least one claim unpatentable and is accompanied by the attached Petition To Withdraw Application From Issue;

b. [ ] 37 C.F.R. §1.313(b)(5), after the issue fee has been paid and information cited in this Information Disclosure Statement is to be considered in a Continuation application upon abandonment of the instant application and is accompanied by the attached Petition To Withdraw Application From Issue.

c. [ ] The fee due under 37 C.F.R. §1.17(i)(1) is paid as set forth in paragraph 10 below.

9. [ ] I hereby certify that each item of information contained in this Information Disclosure Statement was cited in a communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this Information Disclosure Statement.

[ ] I hereby certify that no item of information in the Information Disclosure Statement filed herewith was cited in a communication from a foreign patent office in a counterpart foreign application or, to my knowledge after making reasonable inquiry, was known to any individual designated in §1.56(c) more than three months prior to the filing of this Information Disclosure Statement.

10. [ ] A check in the amount of $130.00 is enclosed in payment of the fee due under 37 C.F.R. §1.17(i)(1).

[ ] Charge the fee due under 37 C.F.R. §1.17(i)(1) to Deposit Account No. 13-4500. Order No.__________. A DUPLICATE COPY OF THIS SHEET IS ATTACHED.

[X] The Commissioner is hereby authorized to charge any additional fees which may be required for this Information Disclosure Statement, or credit any overpayment to Deposit Account No. 13-4500. Order No. 2122-4028. A DUPLICATE COPY OF THIS SHEET IS ATTACHED.

Respectfully submitted,

Dated: February 13, 1996

By: Bruce D. DeRenzi

Bruce D. DeRenzi
Registration No. 33,676

MORGAN & FINNEGAN, L.L.P.
345 Park Avenue
New York, New York 10154
(212) 758-4800
(212) 751-6849 Telecopier

FORM PTO-1449 U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY. DOCKET NO. 2122-4028	SERIAL NO. 08/428,325
INFORMATION DISCLOSURE CITATION *(Use several sheets if necessary)*	APPLICANT Masato Okabe	
	FILING DATE 04/25/95	GROUP

PATENT DOCUMENTS

EXAMINER INITIAL		DOCUMENT NUMBER							DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
		3	9	5	8	2	0	7	5/76	Tutihasi	338	15	
		5	2	9	8	9	4	7	5/94	Aono	355	211	
		5	4	2	4	1	5	6	6/95	Aoki	430	59	

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER							DATE	NAME/COUNTRY	CLASS	SUBCLASS	TRANSLATION YES	TRANSLATION NO
		0	3	4	2	9	6	7	11/89	EPA				
		0	4	0	4	5	7	5	12/90	EPA				
		0	4	5	5	8	2	4	11/91	EPA				
		0	4	2	2	2	3	8	04/91	EPA				
		0	4	5	4	8	6	9	11/91	EPA				
		2	2	4	4	1	5	7	09/90	JAPAN				
		2	2	4	4	1	5	8	09/90	JAPAN				
		4	7	0	7	6	0		03/92	JAPAN				
		5	2	2	8	0			01/93	JAPAN				

OTHER DOCUMENTS *(Including Author, Title, Date, Pertinent Papers, Etc.)*

			M. Hiramoto et al.: Photocurrent Multiplication in Amorphous Silicon Carbide Films; Appl. Phys. Lett.; 59 (16), 1992 (1991).
			M. Hiramoto et al.: Photocurrent Multiplication in Amorphous Silicon Carbide Films; J. Imag. Sci. Technol.; 37 (2), 192 (1993).

EXAMINER	DATE CONSIDERED

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

FORM PTO-1449 U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY. DOCKET NO. 2122-4028	SERIAL NO. 08/428,325
INFORMATION DISCLOSURE CITATION	APPLICANT Masato Okabe	
(Use several sheets if necessary)	FILING DATE 04/25/95	GROUP

PATENT DOCUMENTS

EXAMINER INITIAL		DOCUMENT NUMBER							DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
		5	2	1	3	9	2	2	5/93	Matsuo	430	48	
		4	6	2	8	0	1	7	12/86	Tagoku	430	48	
		5	3	0	8	7	2	4	5/94	Takanushi	430	48	

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER							DATE	NAME/COUNTRY	CLASS	SUBCLASS	TRANSLATION YES	TRANSLATION NO
		2	1	6	9	3			01/90	JAPAN				
		1	2	9	0	3	6	6	11/89	JAPAN				
		1	2	8	9	9	7	5	11/89	JAPAN				
		1	2	9	0	3	6	8	11/89	JAPAN				
		1	2	9	3	3	5	8	11/89	JAPAN				
		1	2	9	3	3	5	9	11/89	JAPAN				
		1	2	9	3	3	6	0	11/89	JAPAN				
		1	2	9	3	3	4	8	11/89	JAPAN				
		1	2	9	6	2	5	5	11/89	JAPAN				

OTHER DOCUMENTS *(Including Author, Title, Date, Pertinent Papers, Etc.)*

			M. Hiramoto et al.: Photocurrent Multiplication Phenomenon in Organic Pigment Film; The Extended Abstract of the 53rd Autumn Meeting of the Japan Society of Applied Physics; 1043 (1992).
			M. Hiramoto et al.: Photocurrent Multiplication in Organic Pigment Films; Final Program and the Proceedings of the 9th International Congress on Advances in Non-Impact Printing Technologies; Japan Hardcopy '93; 671 (1993).

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FORM PTO-1449 U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY. DOCKET NO. 2122-4028	SERIAL NO. 08/428,325
INFORMATION DISCLOSURE CITATION *(Use several sheets if necessary)*	APPLICANT Masato Okabe	
	FILING DATE 04/25/95	GROUP

PATENT DOCUMENTS

EXAMINER INITIAL		DOCUMENT NUMBER							DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
		3	8	2	4	0	9	9	7/16/74	Champ et al.			
		3	8	9	8	0	8	4	8/05/75	Champ et al.			
		3	8	8	7	3	6	6	6/03/75	Champ et al.			

FOREIGN PATENT DOCUMENTS

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		2	7	7	7	8	0		03/90	JAPAN				
		2	8	7	1	4	8		03/90	JAPAN				

OTHER DOCUMENTS *(Including Author, Title, Date, Pertinent Papers, Etc.)*

		M. Hiramoto et al.: Photocurrent Multiplication in Organic Pigment Films; Appl. Phys. Lett; 64 (2), 187 (1994).
		S. Kawase et al: Photocurrent Multiplication Device in Organic Pigment Film; The 67th National Meeting of the Chemical Society of Japan; Abstract No. 670 (1994).

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		4	6	3	2	8	9	3	12/30/86	Rochat et al.			
		4	8	4	2	9	7	0	6/27/89	Tai et al.			
		4	8	7	3	1	6	4	10/10/89	Ono et al.			

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		2	1	7	6	7	6	5	07/90	JAPAN				

OTHER DOCUMENTS *(Including Author, Title, Date, Pertinent Papers, Etc.)*

			T. Yajima et al.:	Mechanism of Photocurrent Multiplication in Organic/Inorganic Layered Photoreceptors Consisting of a-SiC:H; The Proceedings of the Annual Conference of Japan Hardcopy '92 for the Society of Electrophotography of Japan; 221 (1992).
			A. Fujii et al.:	Plastic Devices Using Memory-Type Organic Photoconductor; The Extended Abstract of the 39th Spring Meeting of the Japan Society of Applied Physics and related Societies; 1064 (1992).

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		4	9	1	6	0	3	9	4/10/90	Hashimoto et al.			
		4	8	8	6	8	4	6	12/12/89	Shimada et al.			
		5	0	4	1	6	6	5	8/20/91	Akasaki et al.			

FOREIGN PATENT DOCUMENTS

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		2	2	4	4	0	6	4	09/90	JAPAN				
		2	2	4	4	0	6	2	09/90	JAPAN				

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FORM PTO-FB-AB20
(also form PTO-1449)

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FORM PTO-1449	U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY. DOCKET NO. 2122-4028	SERIAL NO. 08/428,325
INFORMATION DISCLOSURE CITATION		APPLICANT Masato Okabe	
(Use several sheets if necessary)		FILING DATE 04/25/95	GROUP

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EXAMINER INITIAL		DOCUMENT NUMBER							DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
		5	1	6	9	9	8	7	12/08/92	Akasaki et al.			
		4	7	5	1	1	6	3	06/14/88	Hagiwara et al.			
		4	4	2	3	1	2	9	08/22/89	Takasu et al.			

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		DOCUMENT NUMBER							DATE	NAME/COUNTRY	CLASS	SUBCLASS	TRANSLATION YES	TRANSLATION NO
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		4	9	2	5	7	5	9	5/15/90	Hanatani et al.			

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FORM PTO-FB-AB20
(also form PTO-1449)

Patent and Trademark Office - U.S. DEPARTMENT of COMMERCE

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FORM PTO-1449	U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE
ATTY. DOCKET NO. 2122-4028	SERIAL NO. 08/428,325
APPLICANT Masato Okabe	
FILING DATE 04/25/95	GROUP

INFORMATION DISCLOSURE CITATION

(Use several sheets if necessary)

PATENT DOCUMENTS

EXAMINER INITIAL		DOCUMENT NUMBER							DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
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FOREIGN PATENT DOCUMENTS

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		3	2	4	6	5	6	0	11/91	Takanashi et al./JAPAN			X	

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	0 1 1 9 8 7 6 3	8/89	JAPAN				
	0 1 1 8 0 5 5 3	7/89	JAPAN				
	0 1 1 6 4 9 5 4	6/89	JAPAN				

OTHER DOCUMENTS *(Including Author, Title, Date, Pertinent Papers, Etc.)*

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ATTY. DOCKET NO.	SERIAL NO.
2122-4028	08/428,325
APPLICANT: Masato Okabe	
FILING DATE: 04/25/95	GROUP

INFORMATION DISCLOSURE CITATION

(Use several sheets if necessary)

PATENT DOCUMENTS

EXAMINER INITIAL		DOCUMENT NUMBER							DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE

FOREIGN PATENT DOCUMENTS

	DOCUMENT NUMBER								DATE	NAME/COUNTRY	CLASS	SUBCLASS	TRANSLATION YES	TRANSLATION NO
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	6	2	2	8	7	2	5	7	12/87	JAPAN				

OTHER DOCUMENTS *(Including Author, Title, Date, Pertinent Papers, Etc.)*

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FOREIGN PATENT DOCUMENTS

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	0	6	1	3	0	3	4	7	05/94	JAPAN				

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PATENT DOCKET NO. 2122-4028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s)	:	Masato Okabe		
Serial No.	:	08/428,325	**Group:**	TBA
Filed	:	April 25, 1995	**Examiner:**	TBA
For	:	PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD, AND INFORMATION RECORDING SYSTEM		

CONCISE EXPLANATION OF RELEVANCE OF NON-ENGLISH LANGUAGE REFERENCES

ASSISTANT COMMISSIONER FOR PATENTS
Washington, D.C. 20231

Sir:

Applicants submit a brief description of the relevance of the foreign language references which were submitted to or cited by the Patent Office in commonly-owned Application Serial Nos. 08/141,110 and 08/233,672.

M. Hiramoto et al., "Photocurrent Multiplication In Amorphous Silicon Carbide Films", Appl. Phys. Lett. 59(16), 1992 (1991)

This reference describes thin amorphous silicon carbide films having photocurrent multiplication effect caused by the injection of electrons on a conductive zone from electrodes, due to tunnel effect. Results on a thin film of 1μm sandwiched by electrodes is described.

M. Hiramoto et al., "Photocurrent Multiplication In Amorphous Silicon Carbide Films", J. Imag. Sci. Technol., 37(2), 192 (1993)

This reference describes thin amorphous silicon carbide films having photocurrent multiplication effect, caused by the injection of electrons on a conductive zone from electrodes, due to tunnel effect. Results on a thin film of 1μm sandwiched by electrodes is described.

M. Hiramoto et al., "Photocurrent Multiplication Phenomenon In Organic Pigment Film", The Extended Abstract of the 53rd Autumn Meeting of the Japan Society of Applied Physics, 1043 (1992)

This reference describes organic pigment thin film having photocurrent amplification function at temperatures of -10°C or lower. Results on a thin film of 500 nm sandwiched by electrodes is described.

M. Hiramoto et al., "Photocurrent Multiplication in Organic Pigment Films", Final Program and the Proceedings of the 9th International Congress on Advances in Non-Impact Printing Technologies, Japan Hardcopy '93, 671 (1993)

This reference describes organic pigment thin film having photocurrent amplification function at temperatures of -10°C or lower. Results on a thin film of 500 nm sandwiched by electrodes is described. The value of dark current is on the order of several tens of mA/cm^2 or more.

T. Yajima et al., "Mechanism of Photocurrent Multiplication in Organic/Inorganic Layered Photoreceptors Consisting of a-SIC:H", The Proceedings of the Annual Conference of Japan Hardcopy '92 for the Society of Electrophotography of Japan, 211 (1992)

This reference describes the photocurrent multiplication mechanism of an organic/ inorganic laminated photosensitive member using amorphous silicon carbide films. Photocurrent multiplication occurs due to a barrier at the interface between an amorphous silicon carbide layer and an electric charge transport layer.

A. Fuji et al., "Plastic Devices Using Memory-Type Organic Photoconductor", The Extended Abstract of the 39th Spring Meeting of the Japan Society of Applied Physics and Related Societies, 1064 (1992)

This reference describes a photosensitive member having photocurrent multiplication property. An optical sensor with memory property in which conductivity is maintained for more than 3 hours after light irradiation is described.

JP(A)3-246560 (Takanashi et al.)

This reference describes a method for recording optical information by the use of a photoconductive layer of charge injection type.

EP 342,967 A2

EP 342,967 A2 (corresponding to Japanese Laid-Open Patent Application No. 1-290366) discloses a conventional photosensitive member described in the above-identified application from page 28, line 27 to page 29, line 4. As described in EP 342,967 A2 (page 27, line 61 to page 28, line 7) and corresponding Japanese Laid-Open Patent Application No.

1-290366 (page 476, lower right column, lines 11-19), the photosensitive member 1 has originally insulative characteristics but turns to be conductive when receiving light.

The following Japanese references disclose the same photosensitive member feature as above (although some references assign different names to the photosensitive member), and therefore are believed to be substantively cumulative to EP 342,967 A2 (and Japanese Laid-Open Patent Application No. 1-290366): Laid-Open Patent Application Nos. 2-1693, 1-290368, 1-293358 to 1-293360, 1-293348, 1-256254 to 1-296256, 2-56557, 1-295897, 1-298865, 1-298860, 2-77764, 2-77780, 2-87148, 2-93477, 2-262664, 2-153365, 2-173756, 2-176765, 2-230246, 2-230244, 2-275960, 2-242260, 2-244053, 2-244064, 2-244062, 2-244160, 2-244162, 2-244155, 2-244156, 2-244166 to 2-244168, 2-203353, 2-245758 to 2-245760, 2-245763 to 2-245766, 2-245735, 2-245731, 2-245181, 2-245182, 2-245734, 2-275968, 2-275974, 2-275980, 2-289865, 3-158858, 3-158859, 3-158867, 3-158857, 3-170984, 3-170985, 3-170982, 3-172068, 3-175475, 3-192288, 3-200276, 3-231754, 3-7942, 3-7943, 3-15081, 3-15087, 3-54579, 3-20755, 3-20756, 4-46347, 4-40475, 4-70757 to 4-70760, 4-70808, 4-40809, 4-70864, 4-70870 to 4-70871, 4-70842 to 4-70846, 4-70894, 4-73656, 4-73769, 3-174166, 3-219270, 4-336752, 4-337961, 4-362916, 5-2280, 5-107775 to 5-107777, 5-134426, 5-150251, 5-165005, 5-232770, and 5-270140.

2-244157

(1) A Barrier-Control Type Photosensitive Member And A Method For Exposing The Same

(2) FIG. 1 shows a photosensitive member (which includes glass base 101, Au electrode 103, barrier modulation layer 105, and photoconductive layer 107) arranged opposite to an electric charge retaining member (which includes insulation layer 109, electrode 111, and glass base 113).

The barrier modulation layer 105, in which the barrier strength varies according to the amount of exposure, is provided between the electrode 102 and the photosensitive layer 107. The barrier cuts off dark current during the non-exposure state, whereas it is canceled out by carriers generated during the image-exposure state, increasing current amount and enabling to store electric charge upon the electric charge retaining member (page 474, lower left column, lines 14-20). The barrier modulation layer 105 may be made of Cu-doped CdS monocrystal (page 474, lower right column, lines 15-17).

The use of a barrier modulation effect to amplify current is disclosed.

2-244158

(1) A Photosensitive Member Having A Photo-Electron Doubling Effect And An Electrostatic Image Recording Method

(2) FIG. 1 shows photosensitive member 1 which includes supporter 5, electrode 7, insulation layer 8, and photoconductive layer 9, although FIG. 2 omitted the insulation layer 8.

The insulation layer 8 as a dark-current preventing layer is provided between the electrode 7 and the photoconductive layer 9 (page 481, upper right column, lines 1-2). The insulation layer 8 may be made of inorganic metal oxide, such as GeO_2, CeO_2, SiO_2, Al_2O_3, WO_3, etc., or inorganic insulating material, such as SiN, SiC, etc., having the membrane thickness of 100Å to 1000Å formed by the EB vacuum evaporation, sputtering, or the like. (page 481, upper right column, lines 4-16).

The optical arrangement shown in FIG. 2 corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14. Electric charge retaining member 3 includes insulation layer 11, electrode 13, and supporter 15.

The use of an avalanche effect to amplify current is disclosed.

4-70760

(1) An a-Se-Te Photosensitive Member And An Electrostatic Information Recording Method

(2) Photosensitive member 1 shown in FIG. 1(a) includes transparent supporter 5, transparent electrode 7, charge-injection preventing layer 8, a-Se-Te layer 9, and charge transfer layer 10. Alternatively, a-Se layer 9' is formed as shown in FIG. 1(b) (page 697, lower left column, lines 12-17). The a-Se-Te layer 9 serves as a charge generation layer (page 697, lower left column, lines 8-9), and effectively reduces, even when the Te density increases, unexpected thermal generation carriers and injection carriers, thereby preventing an increase of dark current. It also provides panchromatic characteristics in the visible region, and improves sensitivity in the short wavelength region (page 698, upper left column,

lines 14-20). The a-Se layer 9' contributes to reducing more dark current (page 698, upper right column, lines 1-5).

The charge-injection preventing layer 8 is located between the electrode 7 and the a-Se-Te layer 9 (or the a-Se layer 9') to prevent an increase of dark current. The layer 8 has membrane thickness of 0.01μm to 10μm, and is made of SiO_2, Al_2O_3, SiC, SiN by the vacuum evaporation, sputtering, glow discharge, etc. (page 698, lower right column, lines 5-11). Alternatively, the charge-injection preventing layer 8 may be made of materials having the opposite electrode polarity and charge transfer characteristics, to achieve a desired charge-injection preventing effect by the rectifying effect (page 698, lower right column, lines 12-15).

The optical arrangement shown in FIG. 2 corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14. Electric charge retaining member 3 includes insulation layer 11, electrode 13, and supporter 15.

5-2280

(1) An Electrostatic Information Recording Medium And An Electrostatic Information Recording And Reproducing Method

(2) FIG. 1 shows electrostatic information recording medium A to be arranged opposite to electrode plate B or electric charge retaining member C, as shown in FIGs. 2 and 3. The recording medium A includes supporter 1, electrode 2, inorganic oxide layer 3, charge generation layer 4, and charge transfer layer 5.

The inorganic oxide layer 3, provided between the electrode 2 and the charge generation layer 4, blocks dark current generated from the charge injection from the electrode 2 during the voltage application, and serves as an electrostatic information recording layer (column 4, lines 35-40). The inorganic oxide layer 3 provides, if made of SiO_2, the desired electrostatic information recording effect. Alternatively, it may be made of other inorganic oxide, such as, As_2O_3, B_2O_3, Bi_2O_3, CdS, CaO, CeO_2, Cr_2O_3, CoO, GeO_2, HfO_2, Fe_2O_3, La_2O_3, MgO, MnO_2, Nd_2O_3, Nb_2O_5, PbO, Sb_2O_3, SeO_2, Ta_2O_5, WO_3, V_2O_5, Y_2O_5, Y_2O_3, $BaTiO_5$, Bi_2TiO_5, CaO-SrO, CaO-Y_2O_3, Cr-SiO_2, $LiTaO_3$, $PbTiO_3$, $PbZrO_3$, ZrO_2-Co, ZrO_2-SiO_2, or inorganic compound, such as, AlN, BN, NbN, Si_3N_4, TaN, TiN, VN, ZrN, SiC, TiC, WC, Al_4C_3 (page (3), column 4, lines 40-48).

The optical arrangement shown in FIG. 3 corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14. The electric charge retaining member C includes charge retaining layer 23, electrode 22, and supporter 21.

2-1693

(1) An Electrostatic Camera with High Resolution

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

1-290366

(1) An Electrostatic Image Recording And Reproducing Method

(2) This reference was cited and fully explained in the above-identified application on page 2, lines 13-14, and page 61, lines 12-16.

1-289975

(1) A Toner Image Forming Method

(2) This reference was cited and fully explained in the above-identified application from page 1, line 28 to page 2, line 14.

1-290368

(1) An Electrostatic Latent Image Forming System

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

1-293358

(1) A Method For Exposing An Electric Charge Retaining Member

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

1-293359

(1) An Electrostatic Copier

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

1-293360

(1) An Electrostatic Camera Having Voice Information Input Function

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

1-293348

(1) An Electric Charge Retaining Member Recordable Voice/Image Information

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

1-296255

(1) An Electric Charge Retaining Member

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 4 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15), although 1-296255 uses electric-charge retaining reinforced layer 10.

2-56557

(1) An Electric Charge Retaining Member

(2) This reference is similar to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an arrangement among transparent electrode member 1 (supporter 5 and transparent electrode 7), spacer 2, and removable electric-charge retaining member 3 (photoconductive layer 9, insulation layer 11, electrode 13, and supporter 15). The difference is that the electric charge retaining member 3 includes the photoconductive layer 9.

1-296256

(1) An Electric Charge Retaining Member

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

1-296254

(1) An Electrostatic Image Recording Medium And An Electric Charge Retaining Member

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 3 shows an arrangement among photosensitive member 1 (supporter 5, electrode 7, photoconductive layer 9), spacer 2, and electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

1-295897

(1) An Electrostatic Recording Card

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 4 shows an optical system which comprises photosensitive member 2 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

1-298865

(1) An Image Processing System using An Electric Charge Retaining Member

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

1-298860

(1) A Scanner Which Reads And Inputs An Electrostatic Latent Image

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

2-77764

(1) A Voltage-Applying And Exposing Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

2-77780

(1) A Method For Deleting A Latent Image In An Electric Charge Retaining Member

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

2-87148

(1) An Electrostatic Image Recording Medium

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 3 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15), although the insulation layer 11 includes photoconductive or conductive fine particles 12 so as to store electric charges.

2-89081

(1) A Holographic Color Filter

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 16 shows an embodiment applying a holographic color filter to voltage application and exposure to electric charge retaining member 12. 1, 11 are photosensitive members.

2-93477

(1) A Method And Apparatus For Forming Image While Controlling Voltage Application

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

2-153365

(1) A Method For Copying A Negative

(2) This reference is similar to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows negative 1 having electrode 11 and pattern layer 12 (insulation part 12a and conductive part 12b), and electric charge retaining member 2 (insulation layer 21, electrode 22, and supporter 23).

2-262664

(1) An Internal Recording Type Electrostatic Image Recording Medium And An Electrostatic Image Recording Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 3 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15), although the insulation layer 11 includes photoconductive or conductive fine particles 12 and charge transport layer 10.

2-173756

(1) An Electrostatic Image Recording Method And An Electrostatic Image Recorder

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9, discharge reinforced layer 10) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15), although the there is provided the discharge reinforced layer 10.

2-176765

(1) An Electrostatic Image Recording And Reproducing method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15), although the insulation layer 11 includes fine particles 12.

2-230246

(1) A Color Scanner

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 2 shows an optical system which comprises photosensitive member 2 (supporter 2a, electrode 2b, and photosensitive layer 2c) arranged opposite to electric charge retaining member 1 (insulation layer 1a, electrode 1b, and supporter 1c).

2-230244

(1) A System For Protecting Printing Text

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 2 shows an optical system which comprises photosensitive member 2 (supporter 2a, electrode 2b, and photosensitive layer 2c) arranged opposite to electric charge retaining member 1 (insulation layer 1a, electrode 1b, and supporter 1c).

2-275960

(1) An Electric Charge Retaining Member And An Electric Charge Retaining Method.

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 3 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

2-242260

(1) A Photoconductive Fine-Particle Dispersion Type Photosensitive Member

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 2 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

2-244053

(1) A Method For Fabricating An Electric Charge Retaining Member

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 2 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

2-244004

(1) A Method For Making A Color Filter

(2) This reference disclose the prior-art photosensitive mechanism in FIG. 1 (photosensitive member 1, mask 2 and incident light 3, 4).

2-244086

(1) A Method For Copying Color Hologram

(2) FIG. 1 shows photosensitive member 1 and master hologram 2.

2-244064

(1) An Image Recording Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 2 (supporter 2a, electrode 2b, and photosensitive layer 2c) arranged opposite to electric charge retaining member 1 (insulation layer 1a, electrode 1b, and supporter 1c).

2-244062

(1) An Image Recording And Sensitizing Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 2 shows an optical system which comprises photosensitive member 2 (supporter 2a, electrode 2b, and photosensitive layer 2c) arranged opposite to electric charge retaining member 1 (insulation layer 1a, electrode 1b, and supporter 1c).

2-244155

(1) An Electric Charge Retaining Member

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 3 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

2-244156

(1) An Internal Electric Charge Retaining Member

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 2 shows an arrangement among photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9), spacer 2, and electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15), although photoconductive or conductive pattern 14 is formed on the insulation layer 11 and coated by protective layer 20.

2-244160

(1) A Selenium Photosensitive Member And An Electrostatic Image Recording Method

(2) Numeral 10 in FIG. 1(b) is a (transparent) reflection preventing layer. Optionally, a discharge reinforced layer may be provided on photoconductive layer 9 (page 493, lower right column, line 20 to page 494, upper left column, line 1).

The optical arrangement shown in FIG. 2 corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14. Electric

charge retaining member 3 includes insulation layer 11, electrode 13, and supporter 15. Photosensitive member 1 includes supporter 5, electrode 7, and photoconductive layer 9, and is arranged opposite to electric charge retaining member 3.

2-244166

(1) An Image Recording Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 2 (supporter 2a, electrode 2b, and photosensitive layer 2c) arranged opposite to electric charge retaining member 1 (insulation layer 1a, electrode 1b, and supporter 1c).

2-244167

(1) An Image Recording Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 2 (supporter 2a, electrode 2b, and photosensitive layer 2c) arranged opposite to electric charge retaining member 1 (insulation layer 1a, electrode 1b, and supporter 1c).

2-289865

(1) An Electrostatic Camera Using A Photo-Electron-Doubling Tube

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an electrostatic camera using a photo-electron-doubling tube which comprises photosensitive member 120 (transparent base 120a, transparent electrode 120b, and photosensitive layer 120c) arranged opposite to electric charge retaining member 124 (insulation layer 124a, electrode 124b, and base 124c).

2-244168

(1) An Electrostatic Printing Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows photosensitive member 101 (supporter 101a, electrode 101b, photosensitive layer 101c) and electric charge retaining drum 103 (insulation layer 103a, cylindrical electrode 103b, and supporter 103c), although the electric charge retaining member has a drum shape.

2-245645

(1) A Method And Apparatus For Measuring Thermally Stimulated Current

(2) FIG. 1 shows electric charge retaining member 105 connected to a pair of electrodes 101, 103 via spacer 111 in measuring room 100.

2-244162

(1) A Method For Developing An Electrostatic Latent Image By Toner

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1(a) shows an optical system which comprises photosensitive member 101 (transparent supporter 101a, transparent electrode 101b, photosensitive layer 101c), and electric charge retaining drum 103 (insulation layer 103a, electrode 103b, and supporter 103c).

2-275974

(1) An Image Recorder Using A Color Filter

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14 because 2-275974 uses a photosensitive member and an electric charge retaining member (page 5, line 18 to page 6, line 6).

2-245759

(1) An Internal Recording Type Electrostatic Image Recording Medium

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIGs. 5 and 6 show two optical systems. FIG. 5 shows photoconductive fine particles, and FIG. 6 shows conductive fine particles (page 481, upper right column, lines 12-18). In each optical system, photosensitive member 1 includes supporter 5, electrode 7, photoconductive layer 9; electrostatic image recording medium 3 includes insulation layer 11, electrode 13, 13', and supporter 15.

2-245758

(1) An Internal Recording Type Electrostatic Image Recording Medium

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 7 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electrostatic image recording medium 3 (a pair of insulation layer 11, 11', electrode 13, and supporter 15), although between insulation layers 11, 11' is provided photoconductive or conductive fine particles 16.

2-203353

(1) An Electric Charge Retaining Member Having A Protective Membrane

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 2 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

2-245735

(1) An Information Recording Medium And Information Recording And Reproducing Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 3 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to information recording medium 3 (liquid-crystal polymer layer 11, electrode 13, and supporter 15).

2-245764

(1) An Image Forming Member And An Image Forming Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 23.

FIG. 2 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) and electric charge retaining member 3 (insulation layer 10, electrophoresis material layer 11, thermoplastic resin layer 12, electrode 13, and supporter 14).

2-245765

(1) An Information Recording Medium And An Information Recording And Reproducing Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 3 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

2-275980

(1) A Method For Optically Reading A Fine-Particle Pattern

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 101 (supporter 101a, electrode 101b, and photoconductive layer 101c), electric charge retaining member 103 (insulation layer 103a, electrode 103b, and supporter 103c), although insulation layer 1031 includes fine-particle layer 105.

2-245731

(1) An Electro-Optical Reading Method For An Electrostatic Pattern

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 3 shows a view for explaining a method for recording an electrostatic pattern onto electric charge retaining member 103. Photosensitive member 109 includes

supporter 109a, electrode 109b, and photosensitive layer 109c. The electric charge retaining member 103 includes insulation layer 103a, electrode 103b, supporter 103c, and reflection preventing layer 103d.

2-245181

(1) A Method For Cultivating Cells With Electrostatic Patterns

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 3(a) shows a view for explaining a method for forming an electrostatic patten which comprises photosensitive member 104 (supporter 104a, electrode 104b, and photosensitive layer 104c) arranged opposite to electric charge retaining member 105 (insulation layer 105a, electrode 105b, and supporter 105c).

2-245182

(1) A Method For Separating Components In Blood, Body Fluids, etc., Using Electrostatic Patterns

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 3(a) shows a view for explaining a method for forming an electrostatic patten which comprises photosensitive member 104 (supporter 104a, electrode 104b, and photosensitive layer 104c) arranged opposite to electric charge retaining member 105 (insulation layer 105a, electrode 105b, and supporter 105c).

2-245734

(1) An Electric Charge Retaining Member Having An Electro-Optical Layer

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 101 (glass 101a, transparent electrode 101b, and photosensitive layer 101c), and electric charge retaining member 103.

2-245760

(1) A Surface Injection Type Photosensitive Member

(2) FIG. 1 shows two kinds of photosensitive members 1: FIG. 1(イ) shows a first embodiment and FIG. 1(ロ) shows a second embodiment. The photosensitive member shown in FIG. 1(イ) includes supporter 5, electrode 7, and photoconductive layer 9 (Se layer 9a and Br ion doped layer 9b). In FIG. 1(ロ), the photoconductive layer 9 further includes Na ion doped layer 9c.

The optical arrangement shown in FIG. 2 corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14. Electric charge retaining member 3 includes insulation layer 11, electrode 13, and supporter 15.

2-245761

(1) A Photosensitive Member And An Electrostatic Image Recording Method Using A Super-Lattice Avalanche Photodiode

(2) Photosensitive member 1 shown in FIG. 1 includes supporter 5, electrode 7, and photoconductive layer 9 (charge generation layer 9a, super-lattice avalanche photodiode layer 9b, and charge transfer layer 9c).

The optical arrangement shown in FIG. 3 corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14. Electric charge retaining member 3 includes insulation layer 11, electrode 13, and supporter 15.

The use of an avalanche effect to amplify current is disclosed.

2-245762

(1) A Charge-Injection Controllable Photosensitive Member

(2) FIG. 1(ロ) shows another embodiment of photosensitive member 1 which includes supporter 5, electrode 7, and photoconductive layer 9 (emitter layer 9a, base layer 9b, and collector layer 9c).

The optical arrangement shown in FIG. 3 corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14. The photosensitive member 1 is arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

The use of photo-induced radicals or n/i/p/i/n junction to amplify current is disclosed.

2-245763

(1) A Method For Manufacturing A Photosensitive Member Having A Filter

(2) FIG. 2 shows photosensitive member 1 having filter 4. 5 is a supporter, 6 is an adhesive layer, 7 is an electrode layer, and 10 is a carrier film.

The optical arrangement shown in FIG. 6 corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14. The photosensitive member 1 is arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

2-245766

(1) An Amorphous Silicon Photosensitive Member And An Electrostatic Image Recording Method

(2) This reference discloses, in FIG. 1, four-layer photosensitive member 1 which includes supporter 5, electrode 7, a-Si photoconductive layer 9, and charge transfer layer 10. The a-Si layer 9 is layered by the CVD method, sputtering, or the like, upon the electrode layer 7 which has been layered upon the supporter 5. The charge transfer layer 10, which has dielectric constant smaller than amorphous silicon, is then layered on the a-Si layer (page 549, upper left column, lines 9-14). A blocking layer which is made of SiO_2, SiN, SiC, Al_2O_3, or the like and has thickness of 100 to 3000Å, may be provided, if necessary, between the electrode layer 7 and a-Si layer 9 so as to interrupt or reduce charge injection from the electrode 7 to the a-Si layer 9 (page 549, upper left column, lines 15-19). The a-Si layer serves as a charge generation layer (page 549, upper right column, lines 6-7). Optionally, a discharge reinforced layer may be formed upon the photoconductive layer 9 (page 550, upper left column, lines 10-14).

The optical arrangement shown in FIG. 2 corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14. Electric charge retaining member 3 includes insulation layer 11, electrode 13, and supporter 15.

2-275968

(1) An Electrostatic Recording Cassette And A Cassette Type Electrostatic Camera

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 2 shows an optical system which comprises photosensitive member 103 (supporter 103a, electrode 103b, and photoconductive layer 103c), and electric charge retaining member 105 (insulation layer 105a, electrode 105b, and supporter 105c).

3-154875

(1) An Electric Potential Sensor And Potential Measuring Method Using Electro-Optical Crystal

(2) This reference shows a prior art sensor, although an electric potential sensor, which uses electro-optical crystal. The sensor is characterized in a high-resistance compound semiconductor layer formed by epitaxial growth upon a low-resistance compound semiconductor substrate.

3-158858

(1) An Double-Layered Type Information Recording Medium And Information Recording Method

(2) FIG. 1 shows a first embodiment of the information recording medium which comprises a pair of supporters 1, 6, a pair of electrode 2, 5, electric charge retaining layer 3, and photoconductive layer 4, exfoliation layer 7.

The above-identified application explains the information recording method with reference to FIG. 12.

3-158859

(1) A Charge-Injection Type Information Recording Medium And Information Recording Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 2 shows photosensitive member 11 (support 13, electrode 14, and photoconductive layer 15), and charge-injection type information recording medium 12 (charge transfer layer 1, electrode 2, and substrate 3).

3-158867

(1) A Printing System Using An Electric Charge Retaining Member

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 2 (supporter 2a, electrode 2b, and photosensitive layer 2c) arranged opposite to electric charge retaining member 1 (insulation layer 1a, electrode 1b, and supporter 1c).

3-158857

(1) An Electric Charge Retaining Member

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 3 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

3-170984

(1) A Method And Apparatus For Forming Overhead-Projector Text

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 23.

FIG. 1 shows an optical system which comprises photosensitive member 1 (glass base 1a, transparent electrode 1b, and photosensitive layer 1c) arranged opposite to frost film 2 (thermoplastic resin layer 2a, transparent electrode 2b, and supporter 15).

3-170985

(1) A Frost Image Forming Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 23.

FIG. 1 shows an optical system which comprises photosensitive member 1 (glass base 1a, transparent electrode 1b, and photosensitive layer 1c) arranged opposite to frost film 2 (thermoplastic resin layer 2a, transparent electrode 2b, and supporter 15).

3-192288

(1) An Electrostatic Image Transferring And Developing Method

(2) This reference was cited and fully explained in the above-identified application on page 2, lines 14-23.

3-170982

(1) A Method For Copying Electrostatic Information

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 1 (glass base 1a, transparent electrode 1b, and photosensitive layer 1c) arranged opposite to electric charge retaining member 2 (insulation layer 2a, transparent electrode 2b, and supporter 2c).

3-172068

(1) A Method For Optically Reading A Frost Image

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 23.

FIG. 1 shows an optical system which comprises photosensitive member 1 (glass base 1a, transparent electrode 1b, and photosensitive layer 1c) arranged opposite to frost film 2 (thermoplastic resin layer 2a, transparent electrode 2b, and supporter 15).

3-175475

(1) A Method For Forming A Frost Image

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 23.

FIG. 1(c) shows an optical system which comprises photosensitive member 2 (supporter 2a, electrode 2b, and photosensitive layer 2c) arranged opposite to electric charge retaining member 1 (thermoplastic resin layer 1a, electrode 1b, and supporter 1c).

3-192373

(1) An Image Recording Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 2 (supporter 2a, electrode 2b, and photosensitive layer 2c) arranged opposite to electric charge retaining member 1 (insulation layer 1a, electrode 1b, and supporter 1c).

3-200269

(1) A Method And Apparatus For Forming An Image

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 2 (supporter 2a, electrode 2b, and photosensitive layer 2c) arranged opposite to electric charge retaining member 1 (insulation layer 1a, electrode 1b, and supporter 1c).

3-200276

(1) An Apparatus For Forming Overhead-Projector Text

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 23.

FIG. 2 shows an optical system which comprises photosensitive member 2 (supporter 2a, electrode 2b, and photosensitive layer 2c) arranged opposite to electric charge retaining member 1 (insulation layer 1a, electrode 1b, and supporter 1c).. FIG. 1 shows frost-forming electric-charge-retaining-member 10 having thermoplastic resin layer 10a.

3-231754

(1) An a-Selenium-Telluride Photosensitive Member And An Electrostatic Information Recording Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 2 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, a-selenium-telluride layer 9, and charge transfer layer 10) arranged opposite to electric charge retaining member 3 (charge retaining layer 11, electrode 13, and supporter 15).

3-7942

(1) An Electric Charge Retaining Member

(2) This reference was cited in the above-identified application on page 61, lines 4-10.

Also, this reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 3 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

3-7943

(1) An Electrostatic Information Recording Medium And An Electrostatic Information Recording Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 3 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

3-15081

(1) A Method For Correcting Electrostatic Image Potential

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 5 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

3-15087

(1) A Method And Apparatus For Reproducing An Electrostatic Image

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 5 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

3-54579

(1) An Electrostatic Image Recording Cassette And An Apparatus For Recording an Electrostatic Image

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 6 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

3-20755

(1) An Electrostatic Image Recording Label

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 4 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

3-20756

(1) An Electrostatic Image Recording Card

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 9 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

4-40475

(1) An Animation Pickup Device

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 8 shows an optical system which comprises photosensitive member 2 (supporter 2a, electrode 2b, and photosensitive layer 2c) arranged opposite to electric charge retaining member 1 (insulation layer 1a, electrode 1b, and supporter 1c).

4-46347

(1) An Information Recording Medium

(2) This reference was cited in the above-identified application on page 61, lines 16-25.

Also, this reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 2 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

4-70757

(1) A Photosensitive Member And An Electrostatic Information Recording Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

4-70758

(1) An Electrostatic Information Recording Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

4-70759

(1) A Photosensitive Member And An Electrostatic Information Recording Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

4-70808

(1) A Method For Reproducing An Electrostatic Image

(2) As stated in page 61, right column, lines 7-14, electric charge retaining member 5 records photosensitive latent images in accordance with the prior art technique disclosed in the above-identified application from page 1, line 28 to page 2, line 14.

4-70870

(1) A Method For Taking Pictures Of An Electrostatic Images Continuously

(2) FIG. 10 and a description from page 671, right column, line 19 to page 672 upper left column, line 13 explain the prior art technique disclosed in the above-identified application from page 1, line 28 to page 2, line 14.

4-70871

(1) A Method For Exposing An image

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 2 shows an optical system which comprises photosensitive member 10 (supporter 11, transparent electrode 12, and photosensitive layer 13) arranged opposite to electric charge retaining member 20 (insulation layer 23, electrode 22, and supporter 21).

4-70841

(1) A Spacer Type Photosensitive Member

(2) According to FIG. 7 and a description on page 334, upper left column, lines 7-19, this reference uses the prior art technique disclosed in the above-identified application from page 1, line 28 to page 2, line 14.

4-70872

(1) An Spacer Type Electric Charge Retaining Member And A Method For Fabricating It

(2). According to FIG. 3 and a description on page 682, upper left column, lines 2-14, this reference uses the prior art technique disclosed in the above-identified application from page 1, line 28 to page 2, line 14.

4-70887

(1) An Electrostatic Image Recorder

(2) According to FIG. 2 and a description on page 815, left column, line 19 to right column, line 11, this reference uses the prior art technique disclosed in the above-identified application from page 1, line 28 to page 2, line 14.

4-70846

(1) A Color Film Type Recording Medium, A Photosensitive Member, And A Color Image Recording And Reproducing Method

(2) According to FIG. 2 and a description on page 377, right column, lines 11-15, this reference uses the prior art technique disclosed in the above-identified application from page 1, line 28 to page 2, line 14.

4-70845

(1) A Silicon Photosensitive Member And A Method For Controlling Exposure Time

(2) According to FIG. 2 and a description on page 371, right column, lines 1-13, this reference uses the prior art technique disclosed in the above-identified application from page 1, line 28 to page 2, line 14.

4-70842

(1) An Information Recording Medium

(2) This reference was cited in the above-identified application on page 61, lines 4-10.

As shown in FIG. 1, information recording medium 3 includes fine particles 10, insulation resin layer 11, 12, electrode layer 13, photosensitive layer 14, and supporter 15.

4-70809

(1) An Information Recording Medium, An Electrostatic Information Recording Method, And An Electrostatic Information Recording And Reproducing Method

(2) FIG. 1 shows information recording medium 3 which includes electro-optical material layer 11, dielectric mirror layer 12, electrode layer 13, photoconductive layer 14, supporter 15, and electric charge retaining layer 16.

4-70864

(1) An Information Recording Medium And An Electrostatic Information Recording And Reproducing Method

(2) FIG. 1 shows information recording medium 3 including resin member 11, liquid crystal phase 12, electrode layer 13, photosensitive layer 14, and supporter 15.

4-70843

(1) An Information Recording Medium And An Electrostatic Information Recording And Reproducing Method

(2) FIG. 1 shows information recording medium 3 including thermoplastic resin layer 11, dielectric mirror layer 12, electrode layer 13, photosensitive layer 14, and supporter 15.

4-70894

(1) A Method For Reproducing Electrostatic Information

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

4-70844

(1) A Photosensitive Member And A Method For Recording Electrostatic Information

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

4-73656

(1) A Photosensitive Member And An Electrostatic Information Recording Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

4-73769

(1) An Electric Charge Retaining Member And A Method For Recording Electrostatic Information

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 2 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

3-174166

(1) A Negative Using An Electric Charge Retaining Member And A Method For Fabricating It

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 1 (supporter 3, electrode 4, and photosensitive layer 5) arranged opposite to electric charge retaining member 2 (electric charge retaining layer 6 and conductive base 7).

3-219270

(1) A Voltage-Applying And Exposure Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 10 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

4-336752

(1) A Method For Transferring Electrostatic Information Onto A Liquid Crystal Type Information Recording Medium

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 4 shows an optical system which comprises photosensitive member 10 (supporter 11, electrode 12, and photosensitive layer 13) arranged opposite to electric charge retaining member 20 (insulation layer 23, electrode 22, and supporter 21).

4-337961

(1) An Electric Charge Retaining Member And A Method For Reproducing An Electrostatic Latent Image

(2) According to a description on page 336, left column, lines 30-40, this reference uses the prior art technique disclosed in the above-identified application from page 1, line 28 to page 2, line 14. FIG. 1 shows electric charge retaining member 1 having insulation layer 11 and photoconductive layer 12.

6-11727

(1) A Liquid Crystal Recording Medium And A Voltage-Applying And Exposure Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 1 shows an optical system which comprises photosensitive member 1 (transparent supporter 11, transparent electrode 12, and photosensitive layer 13) arranged opposite to liquid crystal recording medium 2 (liquid crystal layer 21, transparent electrode 22, and transparent supporter 23).

4-362916

(1) Information Recording Medium And Electrostatic Information Recording And Reproducing Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 2 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite a liquid crystal polymer composite recording medium.

5-107775

(1) An Electrostatic Information Recording Medium

(2) This reference was cited in the above-identified application on page 61, lines 4-10.

Also, this reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 2 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

5-107776

(1) An Electrostatic Information Recording Medium

(2) This reference was cited in the above-identified application on page 61, lines 4-10.

Also, this reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 5 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

5-107777

(1) An Internal Electric Charge Retaining Member And A Method For Fabricating It

(2) This reference was cited in the above-identified application on page 61, lines 4-10.

This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 2 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

5-134426

(1) An Electrostatic Information Recording Medium

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 2 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

5-165005

(1) An Information Recording Medium And An Information Recording And Reproducing Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 2 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite a liquid crystal polymer composite recording medium.

5-232770

(1) A Method For Correcting Electrostatic Image Potential And An Electric Charge Retaining Member Having Electric Potential Thereon

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 5 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, electrode 13, and supporter 15).

6-48044

(1) An Information Recording Medium And An Information Recording And Reproducing Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 2 shows an optical system which comprises photosensitive member 1 (supporter 5, electrode 7, and photoconductive layer 9) arranged opposite a liquid crystal polymer composite recording medium.

6-18917

(1) An Information Recording Medium And An Information Recording And Reproducing Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 2 shows an optical system which comprises photosensitive member 1 (transparent supporter 5, transparent electrode 7, and photoconductive layer 9) arranged opposite to electric charge retaining member 3 (insulation layer 11, transparent electrode 13, and transparent supporter 15).

5-270140

(1) An Information Recording Medium And An Information Recording And Reproducing Method

(2) This reference corresponds to the prior art example described in the above-identified application from page 1, line 28 to page 2, line 14.

FIG. 2 shows an optical system which comprises photosensitive member 1 (transparent supporter 5, transparent electrode 7, and photoconductive layer 9) arranged opposite to a liquid crystal polymer composite recording medium.

6-18918

(1) An Information Recording Medium And An Electrostatic Information Recording And Reproducing Method

(2) FIG. 2 shows information recording medium 3 including information recording layer 11, transparent electrode 13, organic photoconductive layer 14, and transparent base 15. Numeral 16 denotes a layer including inorganic charge transfer material.

5-150251

(1) A Card Type Liquid Crystal Recording Medium And A Method For Manufacturing The Same

(2) FIG. 1 shows a basic structure of the card type liquid crystal recording medium comprising base 1, electrode 2, photoconductive layer 3 (charge generation layer 3a and charge transfer layer 3b), insulation layer 5, information recording layer 6, common electrode 7, and protective layer 8.

5-238181

(1) A Card Having Liquid Crystal Display Function

(2) FIG. 2 shows card 1 including supporter 3, concave 4, photosensitive layer 5, electrode 6, and protective membrane 7.

5-297351

(1) A Card Type Liquid Crystal Recording Medium And A Method For Manufacturing The Same

(2) FIG. 1 shows a basic structure of the card type liquid crystal recording medium comprising base 1, electrode 2, photoconductive layer 3 (charge generation layer 3a and charge transfer layer 3b), insulation layer 5, information recording layer 6, common electrode 7, and protective layer 8.

5-297352

(1) A Card Type Liquid Crystal Recording Medium And A Method For Manufacturing The Same

(2) FIG. 1 shows a basic structure of the card type liquid crystal recording medium comprising base 1, electrode 2, photoconductive layer 3 (charge generation layer 3a and charge transfer layer 3b), insulation layer 5, information recording layer 6, common electrode 7, and protective layer 8.

5-297353

(1) A Method For Manufacturing A Card Type Liquid Crystal Recording Medium And A Liquid Crystal Recording Medium Manufactured By This Method

(2) FIG. 1 shows a basic structure of the card type liquid crystal recording medium comprising base 1, electrode 2, photoconductive layer 3 (charge generation layer 3a and charge transfer layer 3b), insulation layer 5, information recording layer 6, common electrode 7, and protective layer 8.

A concise explanation of relevance of each of the following additional references has been reproduced and is attached hereto: 05-270140; 06-130347; 01-105956; 62-2267; 01-28652; 01-19356; 01-28650; 01-29848; 01-198761; 01-198762; 01-198763; 01-164954; 56-120649; 01-22969; 01-201668; 01-200362; 01-200361; 01-146843; 01-146845; 01-146846; 01-106864; 01-201670; 01-255861; 34-5466; 59-195660; 01-65555; 01-57263; 64-68761; 01-142654; 01-142655; 01-155357; 01-161245; 01-142643; 02-61644; 04-66022; 01-131215; and 04-70842.*

* The references identified herein may be alternatively referred to by the appropriate prefix in either of two formats; e.g., the prefix "01" may alternatively be referred to as "64".

06–130347 (Application 04–224722)

An information recording medium comprises an electrode layer, a photocondutive layer, an information recording layer (IRL), an electrode layer in order or an electrode layer, a photoconductive layer, a transparent insulating layer, an IRL, an electrode layer in order. At least one of the electrodes is transparent and the IRL comprises a liquid crystal phase and a resin phase.

In an example, a charge generation layer, a charge transporting layer, a transparent insulating layer, an IRL and a transparent electrode were, in order, formed on a transparent ITO electrode formed on a glass baseplate to obtain an information recording medium. The IRL was prepared by applying mixture of 4 pts. wt. dipentaerythritol hexaacrylate, 6 pts. wt. smectic liquid crystals, 0.2 pts. wt. a fluorosurfactant, 0.2 pt. wt. an optical polymerisation initiator and xylene on the transparent insulating layer and irradiating the mixture with 0.3 mJ/cm2 UV at 50 deg. C. When the information recording medium was exposed with a grey scale and a direct current of 1200V was applied between the ITO electrodes for 0.1 sec., an image was formed on the recording layer with sufficient contrast.

Photoreceptor has charge moving layer, charge generating layer, intermediate layer and protective layer successively stacked on electrically conductive base. Charge generating layer includes azo pigment represented by formula (I), and intermediate layer includes polyamide resin. In (I), A is coupler residue. Charge moving substance used in charge moving layer is electron donating substance such as poly-N-vinylcarbazole and derivative, polyvinyl pyrene, polyvinyl phenantrene, oxazole derivative, oxadiazole derivative, imidazole derivative, triphenyl amine derivative, etc. Azo pigment is dissolved in suitable solvent such as methanol, ethanol, isopropanol, acetone, tetrahydrofurane, ethylene glycol dialkylether, etc. Charge generating layer does not include binder resin desired.

An electrophotographic photoreceptor has a photoreceptive layer contg. a charge generating substance of the formula (I), and a charge transporting substance, on a conductive support, of formula (I). In (I) X =H, CH3, C2H5, OCH3, OC2H5, NO2, SO3H, OH, COOH, or halogen. n =1 or 2. R =substd. or unsubstd. alicyclic gp. substd. or unsubstd. heterocyclic gp. or substd. or unsubstd. alkyl gp. The photoreceptor can gain high surface potential (e.g. when subjected to −6 KV corona charging, it has an initial potential of −630 − −940 V), high charge retentivity in the dark (e.g. when stood for 10 sec., it has a charge retentivity of 74−91%), and a high photoreceptivity (e.g. it has a half decay exposure of 1.7−3.2 lux.sec). In addn., it can provide high contrast, clear images, even after repeating the copying process 1,000 times. In an example, a photoreceptor was prepd. e.g. by dispersing 1.5 pts. wt. of (I) into 250 pts. wt. of 1,2−dichloroethane contg. 1 pt. wt. of polyester resin using a ball mill. The dispersion was coated on an aluminium sheet with a wire coater, and drying the coat in air for 30 min. at 120 deg.C. to form a charge generating layer of about 0.5 microns. A soln. contg. 10 pts. wt. of a hydrazone cpd. (e.g. 9−ethylcarbazole−3−carboaldehyde−1,1−diphenylhydrazone), 10 pts. wt. of polyester resin and 100 pts. wt. of 1,2−dichloroethane was coated and dried in air at 60 deg.C for 3 hrs. to form a charge transporting layer 15 microns thick.

01-28652

Photoreceptor has photoconductive layer contg. an organic photoconductive substance laid on an electroconductive support. The organic photoconductive substance is metal phthalocyanine tetraester of general formula (I). In (I), M is metal of Gp.Ib, IIa, IIb, IIIa, IVa, IVb, Vb, VIIb or VIII of periodic table, n is 0 in case M is of gp. Ib, IIa, IIb or VIII, n is 0 or 1, in case is of IIIa, IVb, Vb or VIIb, n is 0, 1 or 2 in case is of IVa, L is halogen, hydroxyl, trialkylsiloxyl, alkoxyl or aryloxyl gp. in case M is of gp. IIIa or IVa, L is oxygen atom in case M is of IV or Vb; L is acyloxy gp. in case M is VIIb, R1, R2, R3 and R4 are each independently, at least 1C alkyl or at least 6C aryl gp.

01-19356

Electrophotographic photoreceptor contains a photoconductive layer contg. (a) metal naphthalocyanine cpd. of formula (I), on a conductive support. In (I), M = Si, Ge or Sn; L and L' = alkyl, aryl, alkoxyl or R5R6R7SiO- possible to bind with Si, Ge or Sn; R5, R6 and R7 = H, alkyl, aryl or alkoxy; R1, R2, R3 and R4 = opt. branched chain alkyl. In an example, mixt. of 2.5 g naphthalocyanine cpd., 5.0 g silicone varnish, 92.5 g methyl ethyl ketone was kneaded for 8 hrs. The dispersion obtd. was applied on an aluminium plate and dried at 90 deg.C for 15 min. to obtain a charge generation layer of 1 micron thick. A 10 g hydrazone cpd. as a charge transport material, 10 g 'S-2000' (RTM) as binder, 40 g methylene chloride and 40 g 1,1,2-trichloroethane were mixed and applied to the charge generation layer and dried at 120 deg.C for 2 hrs. to obtain a charge transport layer. The resulting electrophotographic photoreceptor could accept a surface potential of -1080-1250 V, and had charge retaining rate of 70-78 % after 30-min. lapse, rest potential of 0 V and half decay exposure of 8.5-9.7 lux-sec.

01-28650

Electrophotographic photoreceptor has on a conductive support a photoreceptive layer contg. a trisazo cpd. of formula (I) (X1-3 are -O- or -NR-, R is H or lower alkyl, n is 0-1 and Z1-3 are divalent gp. of formula (i) or (ii) (A is a divalent residue of opt. substd. N-contg. hetero ring or an opt. substd. arylene)).

The photoreceptor has photosensitive layer contg. bisazo-type cpd. of formula (I) on an electroconductive support. In the formula, R is lower alkyl gp.; Z1 and Z2 are (a), (a) where A is divalent (un)substd. heterocyclic ring contg. N atom in the ring or divalent (un)substd. aromatic hydrocarbon.

In an example, pts. wt. bisazo cpd. (R is CH3, A is benzyl) (0.4) was dispersed in 4-methoxy-4-methyl-pentanone-2 (30) and to the dispersion were added polyvinylbutyral (0.2) and phenoxy resin (0.2). The liq. compsn. was applied to Al vapour deposited PET film in 0.2 g/m2 dry wt. so as to form a carrier generation layer. Another liq. compsn. of N-ethylcarbazole-3-aldehyde diphenylhydrazone (90), 4-(p-nitrobenzoyloxy) benzal malononitrile (2), polycarbonate resin (100) and dioxane (670) was applied to the carrier generation layer and dried to provide a 13 microns thick carrier transport layer.

01–198761

A photoconductor has a photosensitive layer which contains a bisazo compound of formula (I) on a conductive support. (R1 and R2 = halogen, or alkyl, alkoxy, nitro, cyano or hydroxy groups. Note that R1 and R2 may be the same or different. Z = atomic group required to form a carbon cyclic aromatic group or heterocyclic aromatic group. Y = atomic group required to form together with a benzene ring a heterocyclic aromatic ring which contains at least gps. of formula (i) (ii) the following.) USE/ADVANTAGE – The photoconductor contains a particular bisazo compound which has a good carrier generating capability. The photoconductor has high sensitivity and low residual potential. It also has high durability, and withstands repeated use. It can use a wide variety of combinations with carrier transferring materials.

01-198762

Electrophotographic photoreceptor contains a biasazo series cpd. of formula (I) in a photosensitive layer formed on a conductive support. In (I), K1 and K2 = coupler moiety having coupling ability and contg. OH gp. A charge transport material used with the bisazo pigment as a charge generation material is pref. e.g., electron acceptive cpd., e.g., 2,4,7-trinitrof uorenone, tetracyanoquinodimethane or electron donor cpd., e.g., carbazole, triarylalkane derivs., phenylenediamine derivs., hydrazone cpds. or stilbene derivs.

In an example, 0.4 pts. wt. bisazo cpd. of formula (I: K1 and K2 = gp. of formula (Ia)) and 30 pts. wt. 4-methoxy-4-methyl-pentanone-2 were dispersed by a sand grinder and 0.2 pt. wt. polyvinylbutyral and 0.2 pt. wt. phenoxy resin was added. The dispersion obtd. was applied on an aluminium-deposited polyester film in a dry coating build-up of 0.2 g/m2 to obtain a charge generation layer. A 90 pts. wt. N-ethylcarbazole-3-aldehydediphenylhydrazone, 2 pts. wt. 4-(p-nitrobenzoyloxy) benzalmalonitrile and 100 pts. wt. polycarbonate resin were dissolved in 670 pts. wt. dioxane. The soln. was applied on the charge generation layer to obtain a charge transfer layer of 13 micron thick. The resultant electrophotoreceptor and a half decay exposure of 3.5 lux-sec.

Electrophotographic photoreceptor contains a bisazo series cpd. of formula (I) or (I') in a photosensitive layer formed on a conductive support. K1 and K2 = coupler moiety having coupling abi ity and contg. OH gp. A charge transport material used with the bisazo pigment as a charge generation material is, e.g., electron acceptor cpd., e.g., 2,4,7-trinitrofluorenone, tetracyanoquinodimethane or electron donor cpd., e.g., carbazole, triarylalkane derivs., phenylenediamine derivs., hydrazone cpds. or stilbene derivs.

01–164954

Electrophotoqraphic photoreceptor comprises a charqe transfer layer (CTL), a charqe qeneration layer (CGL) contq. azo piqment of formula (I), an intermediate layer and a protective layer formed in order on a conductive support. (In (I), X = opt. substd. aromatic or heterocyclic; Ar1 = opt. substd. aromatic or heterocyclic). The charqe transfer material is, e.q. poly–N–vinylcarbazole, pyrene–formaldehyde condensate, oxadiazole deriv. or phenylhydrazones.

2,7-Bis(dialkylamino)pyrene -tetracyanoquinodimethane complexes (1:1) of formula (I). (where R is alkyl) are new. (I) are useful as conductive or heat sensitive materials.

In an example to a soln. of 6 mg. (0.021mmol.) 2,7-bis (dimethylamino)pyrene in hot acetonitrile (3ml) was added dropwise a soln. of 5mg. (0.025 mmol) tetracyanoquinodimethane in hot acetonitrile (3ml). The resulting pptes were filtered and washed with acetonitrile to give 10 mg. of 2,7-bis (dimethylamino)pyrene-tetracyanoquinodimethane complex as dark blue fine crystals, m.pt. at least 230 deg.C.

01-22969

An azo cpd. of formula (I) is new. In (I) each R1-2 =H, alkyl opt. substd., aryl opt. substd. or a heterocyclic ring residue and R1-2 can form a ring together, each R3 =H except when R4 =H, alkyl opt. substd., alkoxy opt. substd., alkylsulphonyl opt. substd. or aryl opt. substd., X =an diazonium residue and n2 =an integer of 1-4. Reaction of a 2-hydroxy-3-carbamoylbenzo(a)carbazole deriv. of formula (II) and a diazonium salt cpd. of formula X(N2Y)n2 (III) (where Y is anionic gp.) gives a cpd. (I).

01-201668

Electrophotographic photoreceptor contains a bisazo cpd. of formula (I) in a photosensitive layer on a conductive support. In (I), R1 and R2 = H, halogen, alkyl, alkoxy, NO2, CN or OH; Z = atomic gp. necessary to form a carbocyclic aromatic or heterocyclic aromatic; X = atomic gp. necessary to form a heterocyclic aromatic gp. which contains gp. of formula (II), (III), (IV), (V) or (VI) as a partia component and is formed by combining with the adjacent benzene ring; m and n = 1, 2or 3.

01–200362

Electrophotographic photoreceptor contains a bisazo cpd. of formula (I) in a photosensitive layer on a conductive support. In (I), R1 and R2 = H, halogen, alkyl, alkoxy, NO2, CN or OH; Z = atomic gp. necessary to form a carbocyclic aromatic or heterocyclic aromatic; X = atomic gp. necessary to form a heterocyclic aromatic gp. which contains gp. of formula (II), (III), (IV), (V) or (VI) as a partial component and is formed by combining with the adjacent benzene ring; m and n = 1, 2 or 3.

01-200361

Electrophotographic photoreceptor contains bisazo cpd of formula (I) in a photosensitive layer on a conductive support. (In (I), R1 and R2 = H, halogen, alkyl, alkoxy, N02, CN or 0H; Z = atomic gp necessary to form a carbocyclic aromatic or heterocyclic aromatic; X = atomic gp necessary to form a heterocyclic aromatic gp which contains gp of formula (II), (III), (IV), (V) or (VI) as a partial component and is formed by combining with the adjacent benzene ring; m and n = 1, 2 or 3.) The photosensitive layer pref contains the bisazo cpd as a carrier generation material and a carrier transport material. The photosensitive layer consists of a carrier generation layer (CGL) and a carrier transport layer (CTL). The carrier transport material is, eg oxazole derivs, thiazole derivs, thiadiazole derivs, triazole derivs, imidazole derivs, imidazolidine derivs, hydrazone cpds, or benzothiazole derivs.

01-146843

Mfg. squarylium cpd. of formula (III) comprises dropping soln. of arylhydroxycyclobutenedione salt of formula (I) in solvent into mixt. of aniline deriv. of formula (II), acidic substance and aliphatic alcohol and opt. reaction solvent: R1-2 is alkyl-, phenyl- or benzyl- opt. substd. independently, each R3-4 is H, alkyl opt. substd., halogen, hydroxyl, carboxyl, carbonamide substd. with alkyl opt. substd. or phenyl, sulphonamide substd. with alkyl opt. substd. or phenyl independently, M is alkali metal, tetraalkylammonium or trialkylammonium-ion, pyridinium or quinolinium-ion opt. substd. each R5-6 is alkyl, phenyl or benzyl- opt. susbtd. independently and R7-8 is H, alkyl opt. substd., halogen, hydroxyl, carboxyl, carbonamide- or sulphonamide-substd. with alkyl opt. substd. or phenyl.

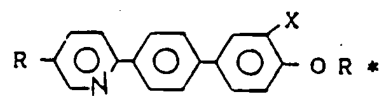
A squarlane cpd. of formula (I) is new. Prepd. by reacting 3,4-dihydroxy-3-cyclo butene-1,2-dione with m-(N,N-diphenylamino)phenol.

In an example, m-(N,N-Diphenylamino) phenol (3.03g) and 3,4-dihydroxy -3-cyclobutene-1,2-dione (0.60g) were heated to reflux in a mixed solvent contg. butanol (50ml) and toluene (25ml) for 3.5 hr.. After cooling, green crystals were filtered and washed with methanol and ether to give cpd. (I) (1.67g, 53% yield). M.pt. = 263 deg.C(decomposed).

01–146846

New squarylium cpd. is of formula (I). In (I) X=H, methyl, F or hydroxyl. (I) is prepd. by reacting 3,4–dichloro–3–cyclobutene 1,2–dione and aniline deriv. of formula (II) to give a chlorocyclobutenedione deriv. of formula (III), hyrdrolysis of the chlorocyclobutenedione deriv. of formula (III), hydrolysis of the chlorocyclobutene dione deriv. to give a hydroxycyclobutenedione deriv. of formula (V) and raction of the hydroxycyclobutenedione deriv. and an aniline deriv. of formula (V) give (I).

An optical active − 2 − biphenylpyridine group denoted in the general formula;



(I)

wherein R is alkyl group of carbon number 1 − 15, R* is optical active group, and X is hydrogen or fluorine.

01–201670

Electrophotographic photoreceptor contains a bisazo cpd. of formula (I) in a photosensitive layer on a conductive support. In (I), R1, and R2 = H, halogen, alkyl, alkoxy, NO2, CN orOH; Z = gp. forming a carbocyclic aromatic or heterocyclic aromatic; m and n = 1–3. Specifically the photosensitive layer contains the bisazo cpd. as a carrier generation material and a carrier transport material. The photosensitive layer comprises a carrier generation layer (CGL) and a carrier transport layer (CTL). The carrier transport material is, e.g., oxazole derivs., thiazole derivs., thiadiazole derivs., triazole derivs., imidazole derivs., imidazolidine derivs., hydrazone cpds., or benzothiazole derivs.

01–255861

Photoreceptor has photosensitive layer including carrier generating substance and carrier transporting substance on electrically conductive base. Carrier generating substance is composed of disazo cpd. of formula (I), and carrier transporting substance is composed of carbazole deriv. of formula (II). The uppermost layer of the photosensitive layer includes polycarbonate of formula (A) as main ingredient of binder. In the formulaes X1 and X2 are halogen, opt. substd. alkyl gp., alkoxy gp., or amio gp., nitro gp., cyano go., or hydroxy gp., and at least one of X1 and X2 is halogen; p and q are 0, 1 or 2 respectively and p and q are not simultaneously 0; X1 and X2 may be same or different when p and q are 2; A is a gp. of formula (a); Ar is aromatic carbon ring having fluorinated hydrocarbon gp., or aromatic heterocyclic gp. having fluorinated hydrocarbon gp., Z is non–metal atomic gp. forming opt. substd. aroamtic carbon ring or aromatic heterocycle; m and n are respectively 0, 1 or 2; m and n are not simultaneously 0; R21 is opt. substd. aryl gp. R22 is H, halogen, opt. susbtd. alkyl or amino gp., alkoxy gp. of hydroxyl gp., R23 is opt. substd. aryl gp. or heterocyclic gp.; R13, R14, R15, R16,R17, R18, R19 and R20 are respectively H, halogen, opt. susbtd. aliphatic gp. or carbon ring gp. and n is 10–1000.

A material for electric photographic duplication comprising an electrically conductive substrate layer and a photoconductive insulating layer being stuck thereon, wherein the insulating layer includes 2,5 bis − (p− aminophenyl) − 1,3,4 − oxidiazole or is composed of compound of them as a photoconductive substance.

Photoreceptor contains (A) a photosensitive layer, contg. at least one of (a) carbazole deriv. of formula (I) and (II), as the effective component, on (B) a conductive support. In the formulae, R1 and R2 are H, alkyl, alkoxy, halogen, dialkylamino, acyl or cyano; R3 and R4 are alkyl, (un)substd. aralkyl or (un)substd. aryl but R3 and R4 are not alkyl at the same time; R5 and R6 are alkyl, aralkyl, (un)substd. aryl and at least one of them is (un)substd. aryl or R5 and R6 may together form a ring or R5 and R6 are hetero atom necessary to form a hetero ring together; n is 1 or 2.

The photoreceptor comprises (A), contg. (a) sensitiser and binder and (B); (A) in which a charge generation cpd. is dispersed in a charge transfer medium comprising (a) and binder and (B); or (B), a charge generation layer contg. a charge generation cpd. and a charge transport layer contg. (a). The charge generation cpd., is e.g. inorganic pigment, e.g. selenium cpd. alpha-silicon etc. organic pigment, e.g., azo pigments, phthalocyanine pigments, etc.. The sensitiser is e.g., Methyl Violet, Crystal Violet, Rhodamine B, etc..

01-65555

Electrophotographic photoreceptor contains at least one kind of hydrazone cpd. of formula (I) in a photosensitive layer, where in (I).

R1 and R2 =H, halogen, opt. substd. alkyl or opt. substd. aryl; R3 and R4 =each opt. substd. alkyl, aryl or alkenyl. The photoreceptor is a single layered one or laminate type one. A charge generation material is, e.g., phthalocyanine cpds., azo pigments, quinone pigments, cyanine cpds. or selenium cpd.

01-57263

Photoreceptor has on a conductive support a photoreceptive layer contg. at least one hydrazone cpd. of formula (I). In (I) Ar1 and Ar2 = opt. substd. arylene; R1 = opt. substd. alkyl, or opt. substd. aryl; R2, R3, R4 and R5 = H, halogen, opt. substd. alkyl, opt. substd. alkoxy or substd. amino.

In an example, on an Al-deposited polyester film is provided a 0.1 micron-thick interlayer made up of vinyl chloride/vinyl acetate/maleic anhdyride copolymer. A dispersion of 1 pt.wt. of dibromoanthrone and 0.5 pt.wt. of polycarbonate in 100 pts.wt. of 1,2-dichloroethane is coated in a dry thickness of 1 micron to form a carrier generating layer. On the carrier generating layer, a soln. of 7.5 pts.wt. of (I) and 10 pts.wt. of polycarbonate in 80 pts.wt. of 1,2-dichloroethane is coated in a dry thickness of 16 microns to form a carrier transporting layer.

A photoconductor has a photosensitive layer on a conductive support. The photosensitive layer contains at least one hydrazone cpd. of formula (I). In (I) Ar1, Ar2, and Ar3 = opt. substd. arylene gp.; R1-5 =H, halogen, opt. substd. alkyl, opt. substd. alkoxy, or substd. amino gp. (I) acts as a charge transferring material. One or more cpds. of formula (I) may be jointly used. As a charge generating material, azodye is pref. a binding agent for the charge generating and transferring materials typically includes polycarbonate, polyester, acrylic, poly(vinyl chloride), polystyrene and methacrylic resin.

01-142654

Electrophotographic photoreceptor contains (a) a pyrrolopyrrole series cpd. of formula(I)and (b) a conjugated cpd. of formula (II) in a photosensitive layer formed on a conductive base. In (I) and (II), R1 and R2 =heterocyclic or aryl or aralkyl opt. substd. by pref., halogen, halogen-contg. lower alkyl, cyano, alkyl, alkoxy or dialkylamino; R3 and R4 =H, alkyl, opt. substd. aryl, pref., H, 1-4C a lower alkyl or phenyl which may be substd. by halogen, halogen-contg. lower alkyl, alkyl, alkoxy, alkylthio or NO2, R5, R6, R7 and R8 =H, lower alkyl, opt. substd. aryl, pref. phenyl may may be subtd. by dialkylamino; at least R5 or R6 or at least R7 or R8 is opt. substd. aryl. Cpd. (b) is opt. used with other charge-transport material, e.g. fluorenone series cpds. nitro cpds., oxadiazole series cpds., carbazole series cpds. or hydrazone series cpds. Cpd. (a) is opt. used with other charge generation material, e.g. Se, Se-Te alloy, azo series cpd., phthalocyanine series cpds., indigo series cpds. or pyrazoline series cpds.

01-142655

Photoreceptor contains (a) a pyrrolopyrrole cpd. of formula (I) and (b) a triphenylamine deriv. of formula (II) in a photosensitive layer formed on a conductive base. In (I)and (II), R1 and R2 = heterocyclic or aryl or aralkyl opt. substd. by pref., halogen, halogen-contg. lower alkyl, cyano, alkyl, alkoxy or dialkylamino; R3 and R4 =H, alkyl, opt. substd. aryl, pref., H, 1-4C lower alkyl, or phenyl opt. substd. by halogen, halogen-contg. lower alkyl, alkyl, alkoxy, alkylthio or NO2; R5, R6, R7, R8 and R9=H, lower alkyl, lower alkoxy or halogen, pref. H, 1-4C alkyl, 1-4C alkoxy or halogen; R10 =H, lower alkyl, aryl or halogen, pref. H, 1-4C alkyl, phenyl or halogen; l = 1 or 2; m, n o and p = integer of 1-3; q = 1 or 2.

01–155357

Photoreceptor with good charging characteristics – contains styryl cpd. as photoconductive or charge transporting material with aniline deriv. in alcohol, etc.

01-161245

Photoreceptor contains a layer contg. (a) styrylbenzoxazole or styrylbenzthiazole cpd. of formula (I) on a support. In (I), R1 and R2 = opt. substd. alkyl, aryl, aralkyl or heterocyclic; R1 and R2 may combine to form a ring; R3, R4 and R5 = H, opt. substd. alkyl, aryl, aralkyl or heterocyclic; R6 = H, alkyl, alkoxy, halogen or NO2; R7 = H, opt. substd. alkyl, aryl, aralkyl or heterocyclic; Ar = opt. substd. aryl or heterocyclic; R7 and Ar may combine to form a ring; X = O or S; n = 0 or 1.

01−142643

In (I), R1, R2, R3, R4, R5 and R6 = H, lower alkyl, lower alkoxy or halogen, pref. H, 1−4C alkyl, 1−4C alkoxy or halogen; R7 = H, lower alkyl, aryl or halogen, pref. , H, 1−4C alkyl, phenyl or halogen.

Cpd. (a) is opt. used with other charge−transport material, e.g., fluorenone series cpds., nitro cpds., oxadiazole series cpds., carbazoles series cpds. or hydrazone series cpds.

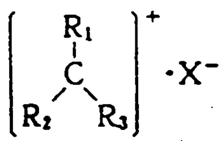
Photoreceptor contains a 4,4'-diaminostilbene deriv. of formula (I) as carrier transporting material, where R= alkyl, alkoxy, or halogen.

ADVANTAGE - The photoreceptor has high photoreceptivity and low residual potential and causes little fatigue upon repeated use in transfer type electrophotography. In addn., (I) has high compatibility with binders.

In an example, a 0.05 micron-thick interlayer made of vinyl chloride-vinyl acetate-maleic anhydride copolymer is on an Al-deposited polyester film. Compsn. prepd. by dispersing 1 g of dibromoanthanthrone into 30 ml of 1,2-dichloroethane with a ball mill, and then dissolving therein 1.5 g of polycarbonate is coated in a dry thickness of 2 micron to form a carrier generating layer. A soln. contg. 5 g of (I) and 10 g of polycarbonate in 80 ml of tetrahydrofuran is coated on the carrier generating layer in a dry thickness of 15 microns to form a carrier transporting layer. The obtd. photoreceptor is charged by 5 second corona discharge of -6KV and exposed to a halogen lamp under illuminance of 2 lux.. Initial surface potential is e.g. -750 - -850 V.

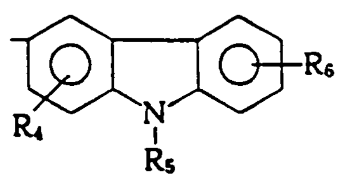
Exposure required for reducing the surface potential to one-half the potential after 5 seconds standing in the dark is e.g. 3.7-4.5 lux sec.. Potential remaining after the exposure of 30 lux sec is e.g. -10 - O V.

A image forming material having memory function provided with a photosensitive memory layer containing a memory effect giving agent composed of organic photoconductive material and arylmethane pigment that is denoted by the following formula (1) on an electrically conductive substrate capable of a hole injection whose surface resistivity is $10^2 - 10^8 \Omega / \square$

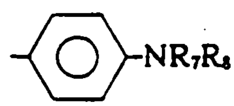


···(1)

wherein at least one of group R1, R2, R3, is a phenyl group whose para position which is denoted by the following formula (2) or (3) is substituted for N,



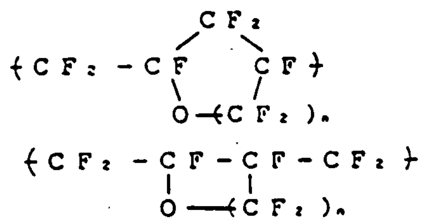
···(2)



···(3)

wherein R4 − R8 is alkyl group, aryl group or hydrogen respectively, two out of group R1, R2, R3, can be alkyl group, aryl group, alkyl group, or hydrogen, and X is anion.

A fluorine containing thermoplastic resinoid polymer having molecular weights such that an intrinsic viscosity is at least 0.1, and comprising essentially a group (a) of circularly structed repeating unit that is denoted by the following general formula wherein n is 1 or 2.



An information recording medium used in a process for the electrostatic information recording reproduction which arranges the information recording medium laminating a photoconductive layer and a charge carrying layer successively on electrode layer, and an opposite electrode, and reproduces the electrostatic information that is recorded in a charge carrying layer after the electrostatic information is recorded in the charge carrying layer by being exposured while applying voltage between both electrodes, wherein the charge carrying layer comprises photoconductive fine particles or electrically conductive fine particles on a insulating resin layer.

P DeRenzi

Case No. 2122-4028 Serial No. 08/428,325

Date Mailed February 13, 1996 ATTY BDD

Date Due in the Patent Office ______________

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P DeRenzi

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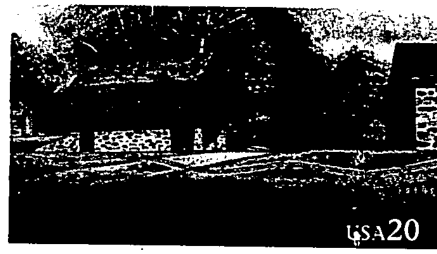

MORGAN & FINNEGAN, L.L.P.

345 PARK AVENUE

NEW YORK, NEW YORK 10154-0053

USPS 1995

Case No. 2122-4028 Serial No. 08/428,325

Date Mailed February 13, 1996 ATTY BDD

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PATENT Docket No. 2122-4028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	:	Masato Okabe	Group Art Unit: TBA
Serial No.	:	08/428,325	Examiner: TBA
Filing Date	:	April 25, 1995	
For	:	PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD, AND INFORMATION RECORDING SYSTEM	

CERTIFICATE OF MAILING (37 C.F.R. §1.8a)

ASSISTANT COMMISSIONER FOR PATENTS
Washington, D.C. 20231

I hereby certify that the attached:

1. Information Disclosure Statement;
2. PTO Form 1449 (22 pages of references);
3. Concise Explanation of Relevance of Non-English Language References and copies of references; and
4. Return postcard

(along with any paper(s) referred to as being attached or enclosed) and this Certificate of Mailing are being deposited with the United States Postal Service on the date shown below with sufficient postage as first-class mail in an envelope addressed to the: Assistant Commissioner of Patents, Washington, D.C. 20231.

Respectfully submitted,

MORGAN & FINNEGAN, L.L.P.

Date: February 13, 1996

By: Bruce D. DeRenzi

Bruce D. DeRenzi
Reg. No. 33,676

Mailing Address:

MORGAN & FINNEGAN, L.L.P.
345 Park Avenue
New York, New York 10154
(212) 758-4800 Telephone
(212) 758-6849 Facsimile

Rev. 121991 M&F

206217_1

CORRESPONDENCE #7

PTO-103X
(Rev. 8-95)

FILING RECEIPT

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APPLICATION NUMBER	FILING DATE	GRP ART UNIT	FIL FEE REC'D	ATTORNEY DOCKET NO.	DRWGS	TOT CL	IND CL
08/428,325	04/25/95	2101	$1,252.00	2122-4028	30	18	5

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MORGAN AND FINNEGAN
345 PARK AVENUE
NEW YORK NY 10154

SEP 22 1997

MORGAN & FINNEGAN

Receipt is acknowledged of this nonprovisional Patent Application. It will be considered in its order and you will be notified as to the results of the examination. Be sure to provide the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION when inquiring about this application. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please write to the Application Processing Division's Customer Correction Branch within 10 days of receipt. Please provide a copy of the Filing Receipt with the changes noted thereon.

Applicant(s)
MASATO OKABE, TOKYO, JAPAN.

FOREIGN/PCT APPLICATIONS-JAPAN	089489	04/27/94
JAPAN	091030	04/17/95

TITLE
PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD, AND INFORMATION RECORDING SYSTEM

PRELIMINARY CLASS: 396

CASE 2122-4028 ATTY CEC/BDD
INFORMATION DISCLOSURE
STATEMENT
FOREIGN FILING
CONVENTION DATE EXPIRES

(see reverse)

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
08/438,325	04/25/95	OKABE M	2122-4028

1999 SEP 20
MORGAN & FINNEGAN LLP

MM12/0915

MORGAN AND FINNEGAN
345 PARK AVENUE
NEW YORK NY 10154

EXAMINER	
MALINOWSKI, W	
ART UNIT	PAPER NUMBER
2871	

DATE MAILED: 09/15/99

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

CASE 2122-4028 ATTY BDD
DUE DATE December 15, 1999
STATUTORY DATE March 15, 2000
BY JZ

PTO-90C (Rev. 2/95)

2 - Mail Copy

Office Action Summary	Application No. 08/428,325	Applicant(s) Okabe
	Examiner Walter Malinowski	Group Art Unit 2871

☒ Responsive to communication(s) filed on *Apr 25, 1995* .

☐ This action is **FINAL**.

☐ Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire 3 month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claims

☒ Claim(s) *1-18* is/are pending in the application.

Of the above, claim(s) ____ is/are withdrawn from consideration.

☐ Claim(s) ____ is/are allowed.

☒ Claim(s) *1-3, 10-12, and 16-18* is/are rejected.

☒ Claim(s) *4-9 and 13-15* is/are objected to.

☐ Claims ____ are subject to restriction or election requirement.

Application Papers

☒ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The drawing(s) filed on ____ is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on ____ is ☐ approved ☐ disapproved.

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

☒ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some* ☒ None of the CERTIFIED copies of the priority documents have been

☒ received.

☐ received in Application No. (Series Code/Serial Number) ____ .

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: ____ .

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

☒ Notice of References Cited, PTO-892

☐ Information Disclosure Statement(s), PTO-1449, Paper No(s). ____

☐ Interview Summary, PTO-413

☒ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

--- SEE OFFICE ACTION ON THE FOLLOWING PAGES ---

DETAILED ACTION

Priority

1. Acknowledgment is made of applicant's claim for foreign priority based on applications filed in Japan on 27 April 1994 and 17 April 1995. It is noted, however, that applicant has not filed a certified copy of the Japanese applications as required by 35 U.S.C. 119(b).

Drawings

2. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference sign(s) not mentioned in the description: part number "63" of Fig. 42 is not identified in the specification. Correction is required.

Specification

3. The abstract of the disclosure is objected to because it is more than one paragraph and should not exceed 260 words in length. Correction is required. See MPEP § 608.01(b).

Claim Objections

4. Claims 4-9 and 13-15 are objected to under 37 CFR 1.75© as being in improper form because a multiple dependent claim may not depend from another multiple dependent Claim.

See MPEP § 608.01(n). Accordingly, the claims 4-9 and 13-15 have not been further treated on the merits.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 1-2, 10-12, and 16-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Takanshi et al. (Takanashi), U.S. Patent No. 5,315,410.

Takanashi discloses a photoelectric sensor including a photoconductive layer on an electrode and used to record information on an information recording medium (column 5, lines 50-60), characterized in that when voltage is applied to the sensor after the sensor has been exposed to light with no voltage applied thereto (as shown in Figs. 3-8; column 7, lines 39-68) or voltage of opposite polarity applied thereto.

Takanashi does not disclose a photo-induced current is generated depending upon exposure quantity so that the information can be recorded on the information recording medium.

Because Takanashi discloses an electric field is applied (column 7, lines 27-30) and light is provided to the photosensitive layer (column 6, line 37), photo-induced currents are generated.

Therefore, as to Claims 1, 2, 10, 17, and 18, it would have been obvious a photo-induced current is generated depending upon exposure quantity so that the information can be recorded on the information recording medium in the device of Takanashi.

Furthermore, as to Claims 2, 10, 17, and 18, Takanashi does not disclose the exposed portion is made higher in conductivity than the unexposed portion and the exposed portion is kept still higher in conductivity than the unexposed portion even after the exposure of the sensor to information light has been finished, and while the sensor remains exposed to information light or after the exposure of the sensor to information light has been finished, nor the application of voltage of opposite polarity is applied thereto, and then the original voltage is again applied thereto, whereby the resulting conductivity is made equal to that obtained by the continued application of voltage.

Takanashi does disclose the impedance of the photoconductive layer 114 varies in accordance with the optical image of the object O, so that the electric field applied to the photo-modulation layer 111 depends on the optical image of object O and the application of the image-dependent electric field to the photo-modulation layer 111 forms a charge latent image on the photo-modulation layer 111 (column 12, lines 21-28). Takanashi also discloses that applied voltage time and amplitude may be varied (column 14, lines 15-25).

It would have been obvious to make the exposed portion higher in conductivity than the unexposed portion and keep the exposed portion still higher in conductivity than the unexposed

portion even after the exposure of the sensor to information light has been finished so that the charge is reliably set in the recording medium.

Furthermore, as to Claims 2, 10, 17, and 18, it is well known to make the sensor exposed to information light or after the exposure of the sensor to information light has been finished, apply voltage of opposite polarity is applied thereto, and then the original voltage is again applied thereto, whereby the resulting conductivity is made equal to that obtained by the continued application of voltage to permit optimization of device performance.

Furthermore, as to Claim 10, Takanashi shows the image recording medium and the photoelectric sensor separated by an air gap (see Fig. 9). Since Takanashi teaches varying the applied voltage, it would have been obvious to optimize performance to comply with the reciprocity law.

Furthermore, as to Claims 17 and 18, Takanashi (see Fig. 10) shows the photoelectric sensor and the information recording medium being stacked on each other. Takanashi shows a mechanism 4 for starting the application of voltage to the electrodes.

As to Claim 11, Takanashi teaches the information recording medium is a liquid crystal recording medium including on the electrode a liquid crystal-polymer composite material layer comprising liquid crystals and resin (column 6, lines 1-5).

As to Claim 12, since shutter speed and recording properties may be varied, it would have been obvious to satisfy the reciprocity law in optimizing performance.

As to Claim 16, Takanashi teaches the voltage applied is controlled.

7. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Takanshi et al. (Takanashi), U.S. Patent No. 5,315,410, as applied to Claims 1-2, 10-12, and 16 above, and further in view of Ando et al. (Ando), U.S. Patent No. 4,692,779, and Shimizu et al. (Shimizu), U.S. Patent No. 5,646,927.

Takanashi makes obvious the photoelectric sensor as claimed in Claim 1 or 2, but does not teach the photoelectric sensor is characterized in that when an electric field of 10^5 to 10^6 V/m is applied to the sensor, a current passing through the unexposed portion has a current density of 10^{-4} to 10^{-7} A/cm^2.

Ando teaches that liquid crystal in an image forming apparatus have electric fields on the order of 10^5 to 10^6 V/m applied (column 4, line 63, through column 5, line 2).

Shimizu teaches generated photocurrent is about 10^{-6} A/cm^2 (column 26, lines 1-8).

Therefore, as to Claim 3, it would have been obvious to use an electric field of 10^5 to 10^6 V/m and a current of 10^{-4} to 10^{-7} A/cm^2, as suggested by Ando and Shimizu, in the device of Takanashi.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Yoshinaga et al., U.S. Patent No. 5,712,066, teach an image forming method and apparatus.

Katagiri et al., U.S. Patent No. 5,327,263, teach an image forming method and apparatus.

Takanashi et al., U.S. Patent No. 5,313,288, teach an image forming method and apparatus.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Walter Malinowski whose telephone number is (703) 308-3172.

Walter Malinowski

Walter Malinowski
Patent Examiner
Group Art Unit 2871

wjm

September 6, 1999

Notice of References Cited

Application No.	Applicant(s)		
08/428,325	Okabe		
Examiner		Group Art Unit	
Walter Malinowski		2871	Page 1 of 1

U.S. PATENT DOCUMENTS

	DOCUMENT NO.	DATE	NAME	CLASS	SUBCLASS
A	5,712,066	Jan/ 1998	Yoshinaga et al.	349	025
B	5,646,927	Jul/ 1997	Shimizu et al.	349	002
C	5,327,263	Jul/ 1994	Katagiri et al.	349	021
D	5,315,410	May/ 1994	Takanshi et al.	349	025
E	5,313,288	May/ 1994	Takanashi et al.	349	025
F	4,692,779	Sep/ 1987	Ando et al.	349	005
G					
H					
I					
J					
K					
L					
M					

FOREIGN PATENT DOCUMENTS

	DOCUMENT NO.	DATE	COUNTRY	NAME	CLASS	SUBCLASS
N						
O						
P						
Q						
R						
S						
T						

NON-PATENT DOCUMENTS

	DOCUMENT (Including Author, Title, Source, and Pertinent Pages)	DATE
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V		
W		
X		

Form PTO 948 (Rev. 10-94) U.S. DEPARTMENT OF COMMERCE - Patent and Trademark Office Application No. ______

NOTICE OF DRAFTSPERSON'S PATENT DRAWING REVIEW

PTO Draftpersons review all originally filed drawings regardless of whether they are designated as formal or informal. Additionally, patent Examiners will review the drawings for compliance with the regulations. Direct telephone inquiries concerning this review to the Drawing Review Branch, 703-305-8404.

The drawings filed (insert date)______________, are
A.____ not objected to by the Draftsperson under 37 CFR 1.84 or 1.152.
B.____ objected to by the Draftsperson under 37 CFR 1.84 or 1.152 as indicated below. The Examiner will require submission of new, corrected drawings when necessary. Corrected drawings must be submitted according to the instructions on the back of this Notice.

1. DRAWINGS. 37 CFR 1.84(a): Acceptable categories of drawings:
   Black ink. Color.
   ___ Not black solid lines. Fig(s)________
   ___ Color drawings are not acceptable until petition is granted. Fig(s) ________
2. PHOTOGRAPHS. 37 CFR 1.84(b)
   ___ Photographs are not acceptable until petition is granted. Fig(s) ________
   ___ Photographs not properly mounted (must use brystol board or photographic double-weight paper). Fig(s)________
   ___ Poor quality (half-tone). Fig(s)________
3. GRAPHIC FORMS. 37 CFR 1.84 (d)
   ___ Chemical or mathematical formula not labeled as separate figure. Fig(s)________
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   ___ Individuals waveform not identified with a separate letter designation adjacent to the vertical axis. Fig(s)________
4. TYPE OF PAPER. 37 CFR 1.84(c)
   ___ Paper not flexible, strong, white, smooth, nonshiny, and durable. Sheet(s)________
   ___ Erasures, alterations, overwritings, interlineations, cracks, creases, and folds copy machine marks not accepted. Fig(s) ________
   ___ Mylar, velum paper is not acceptable (too thin). Fig(s) ________
5. SIZE OF PAPER. 37 CFR 1.84(f): Acceptable sizes:
   21.6 cm. by 35.6 cm. (8 1/2 by 14 inches)
   21.6 cm. by 33.1 cm. (8 1/2 by 13 inches)
   21.6 cm. by 27.9 cm. (8 1/2 by 11 inches)
   21.0 cm. by 29.7 cm. (DIN size A4)
   ___ All drawing sheets not the same size. Sheet(s)________
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6. MARGINS. 37 CFR 1.84(g): Acceptable margins:

Paper size

	21.6 cm. X 35.6 cm. (8 1/2 X 14 inches)	21.6 cm X 33.1 cm. (8 1/2 X 13 inches)	21.6 cm. X 27.9 cm. (8 1/2 X 11 inches)	21.0 cm. X 29.7 cm. (DIN Size A4)
T	5.1 cm. (2")	2.5 cm. (1")	2.5 cm. (1")	2.5cm.
L	.64 cm. (1/4")	.64 cm. (1/4")	.64 cm. (1/4")	2.5 cm.
R	.64 cm. (1/4")	.64 cm. (1/4")	.64 cm. (1/4")	1.5 cm.
B	.64 cm. (1/4")	.64 cm. (1/4")	.64 cm. (1/4")	1.0 cm.

   Margins do not conform to chart above.
   Sheet(s)________
   ___Top (T) ___ Left (L) ___Right (R) ___Bottom (B)
7. VIEWS. 37 CFR 1.84(h)
   REMINDER: Specification may require revision to correspond to drawing changes.
   ___ All views not grouped together. Fig(s)________
   ___ Views connected by projection lines or lead lines. Fig(s)________
   Partial views. 37 CFR 1.84(h) 2
   ___ View and enlarged view not labled separatly or properly. Fig(s)________
   Sectional views. 37 CFR 1.84 (h) 3
   ___ Hatching not indicated for sectional portions of an object. Fig(s)________
   ___ Cross section not drawn same as view with parts in cross section with regularly spaced parallel oblique strokes. Fig(s)________
8. ARRANGEMENT OF VIEWS. 37 CFR 1.84(i)
   ___ Words do not appear on a horizontal, left-to-right fashion when page is either upright or turned so that the top becomes the right side, except for graphs. Fig(s)________
9. SCALE. 37 CFR 1.84(k)
   ___ Scale not large enough to show mechanism with crowding when drawing is reduced in size to two-thirds in reproduction. Fig(s)________
   ___ Indication such as "actual size" or scale 1/2" not permitted. Fig(s)________
10. CHARACTER OF LINES, NUMBERS, & LETTERS. 37 CFR 1.84(l)
   ___ Lines, numbers & letters not uniformly thick and well defined, clean, durable, and black (except for color drawings). Fig(s)________
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   ___ Solid black shading areas not permitted. Fig(s)________
   ___ Shade lines, pale, rough and blurred. Fig(s)________
12. NUMBERS, LETTERS, & REFERENCE CHARACTERS. 37 CFR 1.84(p)
   ___ Numbers and reference characters not plain and legible. 37 CFR 1.84(p)(l) Fig(s)________
   ___ Numbers and reference characters not oriented in same direction as the view. 37 CFR 1.84(p)(l) Fig(s)________
   ___ English alphabet not used. 37 CFR 1.84(p)(2) Fig(s)________
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   ___ Lead lines cross each other. Fig(s)________
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14. NUMBERING OF SHEETS OF DRAWINGS. 37 CFR 1.84(t)
   ___ Sheets not numbered consecutively, and in Arabic numerals, beginning with number 1. Sheet(s)________
15. NUMBER OF VIEWS. 37 CFR 1.84(u)
   ___ Views not numbered consecutively, and in Arabic numerals, beginning with number 1. Fig(s)________
   ___ View numbers not preceded by the abbreviation Fig. Fig(s)________
16. CORRECTIONS. 37 CFR 1.84(w)
   ___ Corrections not made from prior PTO-948. Fig(s)________
17. DESIGN DRAWING. 37 CFR 1.152
   ___ Surface shading shown not appropriate. Fig(s)________
   ___ Solid black shading not used for color contrast. Fig(s)________

COMMENTS:

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Applicant's Copy

CORRESPONDENCE #9

PATENT

Docket No. 2122-4028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s)	:	Masato Okabe	Group Art Unit: 2871
Serial No	:	08/428,325	Examiner: W. Malinowski
Filed	:	April 25, 1995	
For	:	PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD, AND INFORMATION RECORDING SYSTEM	

CLAIM TO CONVENTION PRIORITY

ASSISTANT COMMISSIONER FOR PATENTS
Washington, D.C. 20231

Sir:

In the matter of the above-identified application and under the provisions of 35 U.S.C. §119 and 37 C.F.R. §1.55, applicant(s) claim(s) the benefit of the following prior applications:

Application filed in	: Japan
In the name of	: Dai Nippon Printing Co., Ltd.
Serial No.	: 6-89489
Filing Date	: April 27, 1994

Application filed in	: Japan
In the name of	: Dai Nippon Printing Co., Ltd.
Serial No.	: 7-91030
Filing Date	: April 17, 1995

1. [X] Pursuant to the Claim to Priority, applicant(s) submit(s) duly certified copies of said foreign applications.

2. [ ] A duly certified copy of said foreign application is in the file of application Serial No. ________,

filed ____________________________.

Respectfully submitted,

MORGAN & FINNEGAN, L.L.P.

Dated: October 29, 1999

By: Bruce D. DeRenzi
Bruce D. DeRenzi
Registration No. 33,676

CORRESPONDENCE ADDRESS:
MORGAN & FINNEGAN, L.L.P.
345 Park Avenue
New York, New York 10154
(212) 758-4800
(212) 751-6849 Facsimile

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【発明者】
　【住所又は居所】　東京都新宿区市谷加賀町一丁目１番１号　大日本印刷株式会社内
　【氏名】　岡部　将人
【特許出願人】
　【識別番号】　000002897
　【氏名又は名称】　大日本印刷株式会社
　【代表者】　北島　義俊
【代理人】
　【識別番号】　100091971
　【弁理士】
　【氏名又は名称】　米澤　明
　【選任した代理人】
　　【識別番号】　100088041
　　【弁理士】
　　【氏名又は名称】　阿部　龍吉
　【選任した代理人】
　　【識別番号】　100092495
　　【弁理士】
　　【氏名又は名称】　蛭川　昌信
　【選任した代理人】
　　【識別番号】　100092509

【弁理士】

【氏名又は名称】　白井　博樹

【選任した代理人】

【識別番号】　100095120

【弁理士】

【氏名又は名称】　内田　亘彦

【選任した代理人】

【識別番号】　100095980

【弁理士】

【氏名又は名称】　菅井　英雄

【選任した代理人】

【識別番号】　100094787

【弁理士】

【氏名又は名称】　青木　健二

【選任した代理人】

【識別番号】　100097777

【弁理士】

【氏名又は名称】　韮澤　弘

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【書類名】　明細書

【発明の名称】　光センサーおよび情報記録方法

【特許請求の範囲】

【請求項１】　電極上に光導電層を有し、情報記録媒体への情報形成に使用される光センサーにおいて、光センサーに電圧を印加しない状態、または逆極性の電圧を印加した状態で、露光した後に電圧印加したときに、未露光部に比べて導電性が高くなることを特徴とする光センサー。

【請求項２】　電極上に光導電層を有し、情報記録媒体への情報形成に使用される光センサーにおいて、電圧を印加した状態で情報露光することによって露光部の導電性が未露光部の導電性よりも増加し、情報露光終了後も露光した部分の導電性が、未露光部分の導電性よりも高く、さらに情報露光した状態、または情報露光終了後に、電圧印加を停止、または逆極性の電圧を印加した後、再びもとの電圧を印加することにより、電圧を印加し続けた場合と導電性が等しくなることを特徴とする光センサー。

【請求項３】　光センサーへの１０^{5}～１０^{6}Ｖ／ｃｍ^{2}の電界の印加時に、未露光部での通過電流密度が１０^{-4}～１０^{-7}Ａ／ｃｍ^{2}である請求項１または２記載の光センサー。

【請求項４】　情報露光によって情報記録媒体へ光情報を記録する情報記録再生方法において、請求項１または３記載の光センサーと電極上に情報記録層を形成した情報記録媒体を使用し、光センサーもしくは情報記録媒体の少なくともいずれか一方の電極を透明電極とするとともに、光センサーと情報記録媒体を間隙を設けて光軸上に対向配置し、光情報の露光を行った後に、または光情報の露光中に両電極間に電圧を印加を開始することを特徴とする情報記録方法。

【請求項５】　情報露光によって情報記録媒体へ光情報を記録する情報記録再生方法において、請求項２または３に記載の光センサーと電極上に情報記録層を形成した情報記録媒体を使用し、光センサーもしくは情報記録媒体の少なくともいずれか一方の電極を透明電極とするとともに、光センサーと情報記録媒体を間隙を設けて光軸上に対向配置し、光情報の露光を行うとともに、光情報の露光を行っている間、または光情報の露光終了後に、電圧を印加しない期間もしくは

逆極性の電圧を印加する期間を設けることを特徴とする情報記録方法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】

本発明は、情報記録媒体への光情報を可視情報または静電情報の形で記録することができる光センサーと情報記録媒体からなる情報記録システムに関し、特に情報記録媒体への情報記録性能が著しく増幅される光導電層を有する光センサーおよび情報記録方法に関する。

【０００２】

【従来の技術】

前面に電極が設けられた光導電層からなる光センサーと、該光センサーに対向し、後面に電極が設けられた電荷保持層からなる情報記録媒体とを光軸上に配置し、両導電層間に電圧を印加しつつ露光し、入射光学像に応じて、電荷保持層に静電電荷を記録させ、その静電電荷をトナー現像するかまたは電位読み取りにより再生する方法は、例えば特開平１－２９０３６６号公報、特開平１－２８９９７５号公報に記載されている。また、前記方法における電荷保持層を熱可塑性樹脂層とし、静電電荷を熱可塑樹脂層表面に記録した後加熱し、熱可塑性樹脂層表面にフロスト像を形成することにより記録された静電電荷を可視化する方法は、例えば特開平３－１９２２８８号公報に記載されている。

【０００３】

更に、本出願人等は、前記情報記録媒体における情報記録層を高分子分散型液晶層として、前記同様に電圧印加時露光し、光センサーにより形成される電界により液晶層を配向させて情報記録を行い、情報記録の再生にあたっては透過光あるいは反射光により可視情報として再生する情報記録再生方法を、先に特願平４－１７３０３０号、特願平５－１０１２７７号として出願した。この情報記録再生方法は偏光板を使用しなくとも記録された情報を可視化できる。

このような光センサーと液晶相からなる情報記録層を設けた情報記録方法では、電極間に電圧を印加しつつ情報光を入射させると、光が入射した部分の光導電層で発生した光キャリアは、両電極により形成される電界により移動し、電圧の

再配分が行われ、情報記録層における液晶相が配向し、情報光のパターンに応じた記録が行なわれるものであり、情報光による露光を終了した後も電圧を印加し続けると光センサーは導電性を持続し情報記録層に情報記録を継続することができる。そして、液晶によって動作電圧及びその範囲が異なるものもあるので、印加電圧及び印加電圧時間を設定するにあたっては、情報記録媒体における電圧配分を適宜設定し、情報記録層に印加される電圧配分を液晶の動作電圧領域に設定することが行われており、この情報記録方法は、面状アナログ記録が可能であり、高解像度の記録となり、また露光パターンは液晶相の配向により可視像化されて保持される。

【０００４】

情報記録方法としては、カメラによる方法、またレーザーによる記録方法がある。カメラによる方法としては、通常のカメラに使用されている写真フィルムの代わりに情報記録媒体が使用され、記録部材とするもので、光学的なシャッタも使用しうるし、また電気的なシャッタも使用しうるものである。また、プリズム及びカラーフィルターにより光情報を、Ｒ、Ｇ、Ｂ光成分に分離し、平行光として取り出しＲ、Ｇ、Ｂの各色用の３個の情報記録媒体で１コマを形成するか、または１個の情報記録媒体の異なる部分にＲ、Ｇ、Ｂの各画像を記録して１コマとすることにより、カラー撮影することも可能である。

【０００５】

例えば、ガラス基板上に形成したＩＴＯ膜上にビスアゾ顔料を含有した光導電層を有する光センサーに、２００Ｖの電圧を印加した状態で２０ｌｕｘのグリーン光を露光した場合の電流測定結果を図１に示す。未露光部分Ｌ２に比べて露光部Ｌ１の導電性が増加している。図２は、液晶からなる情報記録媒体をコンデンサと抵抗の並列回路とした時の液晶記録層に印加される電圧を露光部と未露光部についてのシミュレーションの結果を示す。未露光部に比べて露光部の導電性が大きいので、液晶記録層により多くの電圧が印加されるので、露光部の液晶が配向し画像を記録することができる。

このため、図１に示した露光部と未露光部の導電性の差がある程度の大きさにならないと液晶記録媒体に良好な画像を記録することができない。

【０００６】

また、このような方法で電圧を印加する場合、、電圧印加時間と印加電圧には最適値があり、例えば電圧印加時間が長すぎる場合、未露光部の液晶記録媒体も配向し画像記録ができなくなる。

印加電圧を低くすることにより、印加電圧を長くすることもできるが、印加電圧を低くし過ぎた場合には、未露光部の液晶記録媒体の電圧がしきい値電圧に到達しないため、やはり画像記録をすることができない。

以上のように情報記録の際には、規定の時間内に電圧印加を終了する必要があり、それ以上電圧を印加しても有効に情報記録をすることができない。

【０００７】

電圧印加時間は、光センサーあるいは情報記録媒体の特性によって異なるが、ほとんどの場合、２００ｍ秒以内であり、３０～５０ｍ秒程度の電圧印加時間で記録する場合が多く、電圧印加時間は未露光部の電流値により決まり、露光強度や露光時間にはほとんど依存しない。

広範な光強度範囲での記録が可能な銀塩写真では、露光強度の小さい画像を記録する場合に、露光時間を長くすることにより良好な画像を記録することができる。また、弱い光によって長時間露光する場合と強い光で短時間露光する場合のいずれの場合も極端な条件でない限りは同様な画像が記録できる相反則が成立する。

【０００８】

図３は、２００Ｖの電圧を印加した状態で６１ｕｘの光を２００ｍ秒間露光したときの電流値を測定した結果であり、図４および図５は、それぞれ６１ｕｘ、２０１ｕｘで露光したときの露光部分と未露光部分の電流値の差を示している。

６１ｕｘの強度で露光した場合、図４に示すように、長時間露光を続けることにより２０１ｕｘで露光した場合と同程度の未露光部と露光部の差の光電流を得ることができる。

しかし、このような光センサーを用いて情報記録を行う場合、従来と同様に露光と同時に電圧印加を開始する方法では、電圧印加時間は３０～５０ｍ秒程度であるため、６１ｕｘの光で露光した場合には、この時間内では２０１ｕｘの強度

で露光した場合に比べて小さい電流値しか得られないため、良好な画像を記録することができない。

以上のように、従来の方法で情報記録を行う場合、電圧印加時間より長い情報露光を行っても有効に利用することができないため、露光強度が低い場合には情報記録を行うことができない。

【０００９】

【発明が解決しようとする課題】

本発明は、露光強度の低い場合に長時間露光することにより情報記録媒体への情報記録が可能な光センサーおよび情報記録方法を提供することを課題とするものである。

【００１０】

【課題を解決するための手段】

本発明は、電極上に光導電層を有し、情報記録媒体への情報形成に使用される光センサーにおいて、光センサーに電圧を印加しない状態、または逆極性の電圧を印加した状態で、露光した後に電圧印加したときに、未露光部に比べて導電性が高くなる光センサーである。

電極上に光導電層を有し、情報記録媒体への情報形成に使用される光センサーにおいて、電圧を印加した状態で情報露光することによって露光部の導電性が未露光部の導電性よりも増加し、情報露光終了後も露光した部分の導電性が、未露光部分の導電性よりも高く、さらに情報露光した状態、または情報露光終了後に、電圧印加を停止、または逆極性の電圧を印加した後、再びもとの電圧を印加することにより、電圧を印加し続けた場合と導電性が等しくなる光センサーである。

また、光センサーへの１０^5～１０^6Ｖ／ｃｍ^{2}の電界の印加時に、未露光部での通過電流密度が１０^{-4}～１０^{-7}Ａ／ｃｍ^{2}である上記の光センサーである。

【００１１】

情報露光によって情報記録媒体へ光情報を記録する情報記録再生方法において、上記の光センサーと電極上に情報記録層を形成した情報記録媒体を使用し、光センサーもしくは情報記録媒体の少なくともいずれか一方の電極を透明電極とす

るとともに、光センサーと情報記録媒体を間隙を設けて光軸上に対向配置し、光情報の露光を行った後に、または光情報の露光中に両電極間に電圧を印加を開始するこ情報記録方法である。

また、情報露光によって情報記録媒体へ光情報を記録する情報記録再生方法において、上記の光センサーと電極上に情報記録層を形成した情報記録媒体を使用し、光センサーもしくは情報記録媒体の少なくともいずれか一方の電極を透明電極とするとともに、光センサーと情報記録媒体を間隙を設けて光軸上に対向配置し、光情報の露光を行うとともに、光情報の露光を行っている間に、または光情報の露光終了後に電圧を印加しない期間もしくは逆極性の電圧を印加する期間を設ける情報記録方法である。

【0012】

本発明の光センサーは、電極上に光導電層を積層してなり、その光導電層は単層型のものと電荷発生層及び電荷輸送層を積層した積層型のものがある。光導電層は、一般には光が照射されると照射部分で光キャリア（電子、正孔）が発生し、それらのキャリアが層幅を移動することができる機能を有するものであるが、本発明の光センサーは後述する光導電層と電極とを適宜組み合わせ、半導電性を持たせることにより、光センサーへの光照射時において情報記録媒体に付与される電界または電荷量が光照射につれて経時的に増幅され、また光照射を終了した後でも電圧を印加し続けるとその増加した導電性を持続し、引続き電界または電荷量を情報記録媒体に付与し続ける作用を有するに到るものである。

本発明の光センサーは、持続導電性および増幅作用を有しているが、従来から知られている持続導電性を有するといわれている光感光体は、本来は絶縁性のものであり、これに光照射等によって導電性を与える過程において、持続導電性が生じるものである。これに対して、本発明の光センサーは、もともと半導電性の特性を有しており、このことが本発明の作用を得るための要件であり、絶縁性のものでは本発明の作用を得ることはできない。

【0013】

図６は、光センサーを説明するための断面図である。

光センサー１０は、基板１１上に形成した電極１２上に、光導電層１３が設け

られており、光導電層１３は電荷発生層１４および電荷輸送層１５から構成されている。光導電層は光が照射されると照射部分で電子、正孔等の光キャリアが発生し、それらのキャリアが層幅を移動することができる導電性層であり、とくに電界が存在する場合に、その効果が顕著である層である。

電荷発生層１４は、バインダー樹脂と電荷発生性物質からなり、電荷発生性物質としては、特願平５－４７２１号に記載されているようなピリリウム系染料、チアピリリウム系染料、アズレニウム系染料、シアニン系染料、アズレニウム系染料等のカチオン系染料、スクバリリウム塩系染料、フタロシアニン系顔料、ペリレン系顔料、ピラントロン系顔料等の多環キノン系顔料、インジゴ系顔料、キナクリドン系顔料、ピロール系顔料、アゾ系顔料等の染料、顔料を単層中で複数のものを組み合わせて使用することができる。また、電荷発生層を２層設け、それぞれの層に単一の電荷発生性物質を使用してもよい。

また、電荷発生層には、電子受容性物質を添加してもよい。電子受容性物質を添加してもよい。電子受容性物質としては、２，４，７－トリニトロフルオレノン、テトラフルオロ－Ｐ－ベンゾキノン、テトラシアノキノジメタン、トリフェニルメタン、無水マレイン酸、ヘキサシアノブタジエン等を使用することができる。

【００１４】

バインダー樹脂としては、例えばポリ塩化ビニル樹脂、ポリ酢酸ビニル樹脂、アクリル樹脂、ポリエステル樹脂、ポリビニルホルマール樹脂、ポリビニルブチラール樹脂、ポリスチレン樹脂、ポリカーボネート樹脂、ポリブチルメタクリレート樹脂、ポリ塩化ビニリデン樹脂、エチルセルロース樹脂、シリコーン樹脂、エポキシ樹脂、フェノール樹脂、メラミン樹脂、紫外線硬化性樹脂、熱硬化性樹脂、塩化ビニル－酢酸ビニル共重合体樹脂、塩化ビニル－アクリル共重合体樹脂、塩化ビニル－エチレン共重合体樹脂、アクリル－スチレン共重合体樹脂、スチレン－ブタジエン共重合体樹脂、エチレン－酢酸ビニル共重合体樹脂等が挙げられる。

使用するバインダー樹脂は、分子量が大きくなると塗布特性が好ましくないので、平均分子量が１，０００～１００，０００のものを使用することが好ましい

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これらの電荷発生性物質とバインダー樹脂との混合比は、電荷発生性物質１重量部に対してバインダーを０～１０重量部、好ましくは０．３～１重量部の割合で使用するとことが望ましい。電子受容性物質は、電荷発生性物質１モルに対して０，０００１～１０モルの割合で使用することができる。電荷発生層は乾燥後膜厚として０．０１～１μｍであり、好ましくは０．１～０．３μｍとするとよい。

【００１５】

電荷輸送層１５は電荷輸送性物質とバインダーとから構成されている。電荷輸送性物質は、電荷発生性物質で発生した電荷の輸送特性が良い物質であり、例えばオキサジアゾール系、オキサゾール系、トリアゾール系、チアゾール系、トリフェニルメタン系、スチリル系、ピラゾリン系、ヒドラゾン系、芳香族アミン系、カルバゾール系、ポリビニルカルバゾール系、スチルベン系、エナミン系、アジン系、アミン系、ブタジエン系、多環芳香族化合物系等があり、ホール輸送性の良い物質とすることが必要である。

【００１６】

好ましくは、ブタジエン系、スチルベン系電荷輸送性物質が挙げられ、具体的には特開昭６２－２８７２５７号公報、特開昭５８－１８２６４０号公報、特開昭４８－４３９４２号公報、特公昭３４－５４６６号公報、特開昭５８－１９８０４３号公報、特開昭５７－１０１８４４号公報、特開昭５９－１９５６６０号公報、特開昭６０－６９６５７号公報、特開昭６４－６５５５５号公報、特開平１－１６４９５２号公報、特開昭６４－５７２６３号公報、特開昭６４－６８７６１号公報、特開平１－２３００５５号公報、特開平１－１４２６５４号公報、特開平１－１４２６５５号公報、特開平１－１５５３５８号公報、特開平１－１５５３５７号公報、特開平１－１６１２４５号公報、特開平１－１４２６４３号公報等に記載した電荷輸送材料が挙げられる。

これらの電荷発生性物質と電荷輸送性物質の組合せとしては、例えばフルオレノンアゾ顔料（電荷発生性物質）とスチルベン系、トリフェニルアミン系の電荷輸送性物質の組合せ、ビスアゾ系顔料（電荷発生性物質）とブタジエン系、ヒド

ラゾン系の電荷輸送性物質の組合せ等が良好である。

また、以上のように電荷として正孔を輸送することに代えて電子を輸送する場合には、電子輸送物質としては、特願平５－４７２１号に記載の電子輸送物質を用いることができる。

【００１７】

バインダー樹脂としては、上記した電荷発生層におけるバインダー樹脂と同様のものが使用できるが、好ましくはポリ塩化ビニル樹脂、ポリ酢酸ビニル樹脂、アクリル樹脂、ポリエステル樹脂、ポリビニルホルマール樹脂、ポリビニルブチラール樹脂、ポリスチレン樹脂、ポリカーボネート樹脂、ポリブチルメタクリレート樹脂、ポリ塩化ビニリデン樹脂、エチルセルロース樹脂、シリコーン樹脂、エポキシ樹脂、フェノール樹脂、メラミン樹脂、塩化ビニル－酢酸ビニル共重合体樹脂、塩化ビニル－アクリル共重合体樹脂、塩化ビニル－エチレン共重合体樹脂、アクリル－スチレン共重合体樹脂、スチレン－ブタジエン共重合体樹脂、エチレン－酢酸ビニル共重合体樹脂等ポリビニルアセタール樹脂、スチレン樹脂、スチレン－ブタジエン共重合体樹脂が挙げられるが、電荷輸送性物質がバインダー樹脂としての作用を有する場合にはバインダー樹脂の使用は必要がない。使用するバインダー樹脂は、分子量が大きくなると塗布特性が劣化するので、平均分子量が１，０００～１００，０００のものを使用することが好ましい。

バインダー樹脂は、電荷輸送性物質１重量部に対して０．０５～１重量部の割合で使用することが望ましい。電荷輸送層は乾燥後膜厚として１～５０μｍであり、好ましくは５～３０μｍとするとよい。

また、電荷輸送層には、電荷発生層の項で記載した電子受容性物質を同様に電荷輸送性物質１モルに対して電子受容物質を０．０００１～１０モルの割合で、配合することができる。電荷輸送層は、電荷輸送性物質、バインダー樹脂、電子受容物質を電荷発生層の項で記載したと同様の溶剤に溶解、または分散させ、同様の塗布法により電荷発生層上への塗布、乾燥工程を経て、乾燥後膜厚１～５０μｍに形成される。

【００１８】

とくに、本発明の光センサーにおいては、電荷発生性物質と電荷輸送性物質の

相互作用によって光センサーにおいて感度を高くしている。電荷発生効率を高めるためには、電荷輸送層におけるバインダー樹脂の割合を少なくすることが有効であるが、バインダー樹脂の量が少なくなると、電荷輸送層として平滑な層を形成することが困難となり、また光キャリアの発生効率が電荷発生層と電荷輸送層の界面の状態で変化するので、界面が平滑でないと高性能な光センサーを得ることができない。

【００１９】

本発明は、電荷発生層中に電荷輸送層に含まれる電荷輸送性物質を混合することにより、光センサーが高感度化することを見いだしたものである。電荷発生層中に混合する電荷輸送性物質の量は、電荷発生性物質に対してモル比で０．０１～１０であることが好ましく、０．１～１であることがとくに好ましく、０．０１以下であると添加の効果が得られず、１０以上である場合には、暗電流が小さく、本発明の情報記録方法に適さないので好ましくない。

また、電荷発生層中に混合する電荷輸送性物質は、電荷発生層に積層する電荷輸送層に使用する電荷輸送性物質と同一の電荷輸送性物質を使用しても良いし、あるいはこれらとは異なる電荷輸送性物質を用いても良い。

【００２０】

電極１２は、後述する情報記録媒体が不透明であれば透明性を有することが必要であるが、情報記録媒体が透明性を有する場合には透明、不透明いずれでもよく、５０～１０４　Ω／cm２　の表面抵抗率を安定して与える材料、例えば亜鉛、チタン、銅、鉄、錫等の金属薄膜導電膜、酸化錫、酸化インジウム、酸化亜鉛、酸化チタン、酸化タングステン、酸化バナジウム等の無機金属酸化物導電膜、四級アンモニウム塩等の有機導電膜等であり、単独か或いは二種以上の複合材料として用いられる。なかでも酸化物半導体が好ましく、特に酸化インジウム酸化錫複合酸化物（ＩＴＯ）が好ましい。

【００２１】

電極１２は蒸着、スパッタリング、ＣＶＤ、コーティング、メッキ、ディッピング、電解重合等の方法により形成される。またその膜厚は電極を構成する材料の電気特性、および情報記録の際の印加電圧により変化させる必要があるが、例

えばＩＴＯ膜では１０～３００ｎｍ程度であり、情報記録層との間の全面、或いは光導電層の形成パターンに合わせて形成される。

基板１１は、後述する情報記録媒体が不透明であれば透明性を有することが必要であるが、情報記録媒体が透明性を有する場合には透明、不透明いずれでもよく、カード、フィルム、テープ、ディスク等の形状を有し、光センサーを強度的に支持するものである。光センサー自体が支持性を有する場合には設ける必要がないが、光センサーを支持することができるある程度の強度を有していれば、その材質、厚みは特に制限がない。例えば可撓性のあるプラスチックフィルム、或いはガラス、ポリエステル、ポリカーボネート等のプラスチックシート、カード等の剛体が使用される。

なお、基板の電極１２が設けられる面の他方の面には、電極１２が透明であれば必要に応じて反射防止効果を有する層を積層するか、また反射防止効果を発現しうる膜厚に透明基板を調整するか、更に両者を組み合わせることにより反射防止性を付与するとよい。

【００２２】

次に、本発明の情報記録方法について説明する。図７は、本発明の方法に使用する情報記録装置を説明する断面図である。光センサー１０と情報記録媒体２０がスペーサ１６を介して対向配置し積層して構成される。

情報記録媒体２０について説明する。まず、本発明における情報記録媒体としては、その情報記録層が高分子分散型液晶とする場合が挙げられる。

高分子分散型液晶は樹脂相と液晶相からなり、液晶相中に樹脂粒子が分散した構造を有しているが、液晶材料は、スメクチック液晶、ネマチック液晶、コレステリック液晶あるいはこれらの混合物を使用することができる。液晶としては、その配向性を保持し、情報を永続的に保持させるのでメモリー性の観点から、スメクチック液晶を使用するのが好ましい。

スメクチック液晶としては、液晶性を呈する物質の末端基の炭素鎖が長いシアノビフェニル系、シアノターフェニル系、フェニルエステル系、更に弗素系等のスメクチックＡ相を呈する液晶物質、強誘電性液晶として用いられるスメクチックＣ相を呈する液晶物質、或いはスメクチックＨ、Ｇ、Ｅ、Ｆ等を呈する液晶物

質等が挙げられる。

【００２３】

又、ネマチック液晶を使用してもよく、スメクチック或いはコレステリック液晶と混合することによりメモリー性を向上させることができ、例えば、シッフ塩基系、アゾキシ系、アゾ系、安息香酸フェニルエステル系、シクロヘキシル酸フェニルエステル系、ビフェニル系、ターフェニル系、フェニルシクロヘキサン系、フェニルピリジン系、フェニルオキサジン系、多環エタン系、フェニルシクロヘキセン系、シクロヘキシルピリミジン系、フェニル系、トラン系等の公知のネマチック液晶を使用できる。又、ポリビニルアルコール等と液晶材料を混合してマイクロカプセル化したものも使用できる。なお、液晶材料を選ぶ際には、屈折率の異方向性の大きい材料の方がコントラストがとれるので好ましい。

【００２４】

樹脂粒子を形成する材料としては、例えば、紫外線硬化型樹脂であって、モノマー、オリゴマーの状態で液晶材料と相溶性を有するもの、或いはモノマー、オリゴマーの状態で液晶材料と共通の溶媒に相溶性を有するものを好ましく使用できる。このような紫外線硬化型樹脂としては、例えばアクリル酸エステル、メタクリル酸エステル等が挙げられ、モノマー、オリゴマーの状態で、例えばジペンタエリスリトールヘキサアクリレート、トリメチロールプロパントリアクリレート、ポリエチレングリコールジアクリレート、ポリプロピレングリコールジアクリレート、イソシアヌール酸（エチレンオキサイド変性）トリアクリレート、ジペンタエリスリトールペンタアクリレート、ジペンタエリスリトールテトラアクリレート、ネオペンチルグリコールジアクリレート、ヘキサンジオールジアクリレート等の多官能性モノマー或いは多官能性ウレタン系、エステル系オリゴマー、更にノニルフェノール変性アクリレート、Ｎ－ビニル－２－ピロリドン、２－ヒドロキシ－３－フェノキシプロピルアクリレート等の単官能性モノマー或いはオリゴマー等が挙げられる。

溶媒としては、使用材料に共通の溶媒であれば特に問題はなく、例えばキシレン等に代表される炭化水素系溶媒、クロロホルム等に代表されるハロゲン化炭化水素系溶媒、メチルセロソルブ等に代表されるアルコール誘導体系溶媒、ジオキ

ン等に代表されるエーテル系溶媒等が挙げられる。

【００２５】

紫外線硬化型樹脂を硬化させる光硬化剤としては、例えば２－ヒドロキシ－２－メチル－１－フェニルプロパン－１－オン（メルク社製　ダロキュア１１７３）、１－ヒドロキシシクロヘキシルフェニルケトン（チバ・ガイギー社製　イルガキュア１８４）、１－（４－イソプロピルフェニル）－２－ヒドロキシ－２－メチルプロパン－１－オン（メルク社製　ダロキュア１１１６）、ベンジルジメチルケタール（チバ・ガイギー社製　イルガキュア６５１）、２－メチル－１－〔４－（メチルチオ）フェニル〕－２－モルホリノプロパノン－１（チバ・ガイギー社製　イルガキュア９０７）、２，４－ジエチルチオキサントン（日本化薬社製　カヤキュアＤＥＴＸ）とｐ－ジメチルアミノ安息香酸エチル（日本化薬社製カヤキュアＥＰＡ）との混合物、イソプロピルチオキサントン（ワードブレキンソップ社製　クンタキュア・ＩＴＸ）とｐ－ジメチルアミノ安息香酸エチルとの混合物等が挙げられるが、液状である２－ヒドロキシ－２－メチル－１－フェニルプロパン－１－オンが液晶材料、重合体形成性モノマー若しくはオリゴマーとの相溶性の面で特に好ましい。

液晶材料と樹脂の使用割合は、液晶の含有量が１０～９０重量%、好ましくは４０～８０重量%となるように使用するとよく、１０重量%未満であると情報記録により液晶相が配向しても光透過性が低く、また、９０重量%を越えると液晶の滲み出し等の現象が生じ、画像ムラが生じ好ましくない。液晶は情報記録相中に多く存在させることにより、コントラスト比を向上させ、動作電圧を低くすることができる。

【００２６】

情報記録層の形成方法は、樹脂形成用材料と液晶、光硬化剤等を溶媒に溶解または分散させた混合溶液を、電極上にブレードコーター、ロールコーター、或いはスピンコーター等の塗布方法により塗布し、光または熱により樹脂形成用材料を硬化させることにより形成される。なお、必要に応じて、溶液の塗布適性を向上させ、表面性を良くするためにレベリング剤を添加してもよい。

情報記録層形成にあたっては、樹脂形成用材料と液晶との混合液が等方相を保

持する温度以上に混合溶液を加熱し、液晶と紫外線硬化型樹脂形成材料とを完全に相溶させることが必要であり、これにより、樹脂相と液晶相とが均一に分散した情報記録層とすることができる。液晶が等方相を示す温度以下で紫外線硬化させると、液晶と紫外線硬化型樹脂材料との相分離が大きくなるという問題が生じる。すなわち、液晶ドメインが成長しすぎ、情報記録層表面にスキン層が完全に形成されず、液晶の滲み出し現象が生じたり、また紫外線硬化型樹脂がマット化し、正確に情報を取り込むことが困難となり、好ましくなく、紫外線硬化型樹脂が液晶を保持できず、情報記録層を形成されないことすらある。他方、溶媒を蒸発させる際に、等方相を保持するために加熱が必要な場合には、特に電極に対する濡れ性が低下し、均一な情報記録層が得られないという問題がある。

【００２７】

電極に対する濡れ性を維持するとともに樹脂の表面に被膜を形成することを目的として、情報記録層に弗素系界面活性剤を添加するとよい。このような弗素系界面活性剤としては、例えば住友スリーエム（株）製、フロラードＦＣ－４３０、同フロラードＦＣ－４３１、Ｎ－（ｎ－プロピル）－Ｎ－（β－アクリロキシエチル）－パーフルオロオクチルスルホン酸アミド（三菱マテリアル（株）製ＥＦ－１２５Ｍ）、Ｎ－（ｎ－プロピル）－Ｎ－（β－メタクリロキシエチル）－パーフルオロオクチルスルホン酸アミド（三菱マテリアル（株）製ＥＦ－１３５Ｍ）、パーフルオロオクタンスルホン酸（三菱マテリアル（株）製ＥＦ－１０１）、パーフルオロカプリル酸（三菱マテリアル（株）製ＥＦ－２０１）、Ｎ－（ｎ－プロピル）－Ｎ－パーフルオロオクタンスルホン酸アミドエタノール（三菱マテリアル（株）製ＥＦ－１２１）、更に三菱マテリアル（株）製ＥＦ－１０２、同ＥＦ－１０３、同ＥＦ－１０４、同ＥＦ－１０５、同ＥＦ－１１２、同ＥＦ－１２１、同ＥＦ－１２２Ａ、同ＥＦ－１２２Ｂ、同ＥＦ－１２２Ｃ、同ＥＦ－１２２Ａ３、同ＥＦ－１２３Ａ、同ＥＦ－１２３Ｂ、同ＥＦ－１３２、同ＥＦ－３０１、同ＥＦ－３０３、同ＥＦ－３０５、同ＥＦ－３０６Ａ、同ＥＦ－５０１、同ＥＦ－７００、同ＥＦ－２０１、同ＥＦ－２０４、同ＥＦ－３５１、同ＥＦ－３５２、同ＥＦ－８０１、同ＥＦ－８０２、同ＥＦ－１２５ＤＳ、同ＥＦ－１２００、同ＥＦ－Ｌ１０２、同ＥＦ－Ｌ１５５、同ＥＦ－Ｌ１７４、同ＥＦ－Ｌ

5等が挙げられる。また、3－（2－パーフルオロヘキシル）エトキシ－1，2－ジヒドロキシプロパン（三菱マテリアル（株）製MF－100）、N－n－プロピル－N－2，3－ジヒドロキシプロピルパーフルオロオクチルスルホンアミド（三菱マテリアル（株）製MF－110）、3－（2－パーフルオロヘキシル）エトキシ－1，2－エポキシプロパン（三菱マテリアル（株）製MF－120）、N－n－プロピル－N－2，3－エポキシプロピルパーフルオロオクチルスルホンアミド（三菱マテリアル（株）製MF－130）、パーフルオロヘキシルエチレン（三菱マテリアル（株）製MF－140）、N－（3－トリメトキシシリル）プロピル）パーフルオロヘプチルカルボン酸アミド（三菱マテリアル（株）製MF－150）、N－（3－トリメトキシシリル）プロピル）パーフルオロヘプチルスルホンアミド（三菱マテリアル（株）製MF－160）等が挙げられる。弗素系界面活性剤は、液晶と樹脂形成材料との合計量に対して0．1～20重量％の割合で添加される。

【0028】

また、情報記録層形成における塗布溶液における固形分濃度は10～60重量％とするとよく、硬化に際して、樹脂の種類、濃度、塗布層温度、また紫外線照射条件等の硬化条件を適宜に設定することにより、外表皮層として液晶相を有しない樹脂層のみからなるスキン層を良好に形成させることができ、これにより情報記録層における液晶の使用割合を増大することができ、また液晶の滲み出しを無くすることができる。

以上、樹脂材料として紫外線硬化型樹脂について説明したが、その他、液晶材料と共通の溶媒に相溶性を有する溶媒可溶型の熱硬化性樹脂、例えばアクリル樹脂、メタクリル樹脂、ポリエステル樹脂、ポリスチレン樹脂、及びこれらを主体とした共重合体等、エポキシ樹脂、シリコーン樹脂等を使用してもよい。

情報記録層の膜厚は解像性に影響を与えるので、乾燥後膜厚0．1～10μm、好ましくは3～8μmとするとよく、高解像性を維持しつつ、動作電圧も低くすることができる。膜厚が薄すぎると情報記録部のコントラストが低く、また、厚すぎると動作電圧が高くなるので好ましくない。

【００２９】

なお、情報記録層がそれ自体支持性を有し、支持体を省略する場合には、情報記録層の表面にはスキン層が形成されているので、例えばＩＴＯ膜を蒸着法、スパッタ法等により積層してもひび割れが生じなく、導電性の低下のないものとできる。この場合、仮支持体上に設けた情報記録層上に電極を設けた後、仮支持体を剥離して情報記録媒体とするとよい。

【００３０】

情報記録媒体の基板２１上に電極２２が積層され、電極上には情報記録層２３が形成されている。電極２２は、上述の光センサーにおける電極１２と同様の材料、及び同様の積層方法で基板２１上に設けられる。

この情報記録媒体は、図７に示すように上述した光センサーとスペーサー１６を介して、対向配置し、両電極１２、２２を電圧源Ｖを介して結線して第１の情報記録装置とされる。この装置における電極１２、２２は、いずれか一方、または両方が透明であればよい。

スペーサーとしては、ポリエチレンテレフタレート等のポリエステル、ポリイミド、ポリエチレン、ポリ塩化ビニル、ポリ塩化ビニリデン、ポリアクリロニトリル、ポリアミド、ポリプロピレン、酢酸セルロース、エチルセルロース、ポリカーボネート、ポリスチレン、ポリテトラフルオロエチレン等の樹脂フィルムを使用して形成するとよく、また、上記各樹脂溶液を塗布、乾燥させて形成してもよい。また、アルミニウム、セレン、テルル、金、白金等の金属材料又は無機或いは有機化合物を蒸着して形成してもよい。スペーサーの膜厚は、光センサーと情報記録媒体との空隙距離となり、情報記録層に印加される電圧配分に影響を与えるので、少なくとも１００μｍ以下とするとよく、好ましくは３～３０μｍとするとよい。

【００３１】

また、本発明の情報記録装置は、光センサーと情報記録媒体を間隙を設けて配置する以外に、光センサーの光導電層上に絶縁性の誘電体層を形成した後に、情報記録層および上部電極を形成しても良い。

誘電体層を形成する材料としては、無機材料では SiO_2 、TiO_2、CeO_2、Al_2O_3

、GeO_2、Si_3N_4、AlN 、TiN 等を使用し、蒸着法、スパッタ法、化学蒸着（ＣＶD）法等により積層して形成するとよい。また、有機溶剤に対して相溶性の少ない水溶性樹脂、例えばポリビニルアルコール、水系ポリウレタン、水ガラス等の水溶液を使用し、スピンコート法、ブレードコート法、ロールコート法等により積層してもよい。更に、塗布可能なフッ素樹脂を使用してもよく、この場合にはフッ素系溶剤に溶解し、スピンコート法により塗布するか、またブレードコート法、ロールコート法等により積層してもよい。

塗布可能なフッ素樹脂としては、例えば特開平１－１３１２１５号公報等に開示されたフッ素樹脂、更に真空系で膜形成されるポリパラキシリレン等の有機材料を好ましく使用することができる。

【００３２】

次に、本発明の情報記録装置への情報記録方法について説明する。図８は、本発明の光センサーを使用した情報記録方法を説明する図である。

情報光によって露光の後に、電極１２、２２間に電圧を印加、情報光１７による露光とともに印加電圧を断続的に供給、あるいは電圧の印加を停止した後に再度電圧を印加する等の電圧の印加を制御する制御装置１８を有しており、光が入射した部分の電荷発生層１４、電荷輸送層１５からなる光導電層で発生した光キャリアは、両電極により形成される電界により移動し、電圧の再配分が行われ、情報記録層における液晶相が配向し、情報光１７のパターンに応じた記録が行なわれる。なお、情報光１７を入射しつつ、電圧を所定時間印加してもよい。

【００３３】

また、液晶によって動作電圧及び範囲が異なるものもあるので、印加電圧及び印加電圧時間を設定するにあたっては、情報記録媒体における電圧配分を適宜設定し、情報記録層にかかる電圧配分を液晶の動作電圧領域に設定するとよい。この情報記録方法は、面状アナログ記録が可能であり、液晶レベルでの記録が得られるので、高解像度の記録となり、また露光パターンは液晶相の配向により可視像化されて保持される。

【００３４】

情報記録方法としては、カメラによる方法、またレーザーによる記録方法があ

る。カメラによる方法としては、通常のカメラに使用されている写真フィルムの代わりに情報記録媒体が使用され、記録部材とするもので、光学的なシャッタも使用しうるし、また電気的なシャッタも使用しうるものである。また、プリズム及びカラーフィルターにより光情報を、Ｒ、Ｇ、Ｂ光成分に分離し、平行光として取り出しＲ、Ｇ、Ｂの各色用の３個の情報記録媒体で１コマを形成するか、または１個の情報記録媒体の異なる部分にＲ、Ｇ、Ｂの各画像を記録して１コマとすることにより、カラー撮影することもできる。

【００３５】

また、レーザーによる記録方法としては、光源としてはアルゴンレーザー（５１４．４８８ｎｍ）、ヘリウムーネオンレーザー（６３３ｎｍ）、半導体レーザー（７８０ｎｍ、８１０ｎｍ等）が使用でき、画像信号、文字信号、コード信号、線画信号に対応したレーザー露光をスキャニングにより行うものである。画像のようなアナログ的な記録は、レーザーの光強度を変調して行い、文字、コード、線画のようなデジタル的な記録は、レーザー光のＯＮ－ＯＦＦ制御により行う。また画像において網点形成されるものには、レーザー光にドットジェネレーターにＯＮ－ＯＦＦ制御を行って形成するものである。

【００３６】

情報記録媒体に記録された露光情報は、情報記録媒体を分離し、透過光により情報を再生すると、情報記録部では液晶が電界方向に配向するために光は透過するのに対して、情報を記録していない部位においては光は散乱し、情報記録部とのコントラストがとれる。また、これらの情報記録装置で記録された情報は、反射光により読み取ってもよい。

液晶の配向により記録された情報は、目視による読み取りが可能な可視情報であるが、投影機により拡大して読み取ることもでき、レーザースキャニング、或いはＣＣＤを用いて透過光、または反射光により高精度で情報を読み取ることができ、必要に応じてシュリーレン光学系を用いることにより散乱光を防ぐことができる。

【００３７】

本発明の情報記録装置における情報記録媒体は、静電情報を液晶の配向により

可視化した状態で記録するものであるが、液晶と樹脂との組合せを選ぶことにより、一度配向し可視化した情報は消去せず、メモリ性が付与される。また、等方相転移付近の高温に加熱すると、メモリー性を消去することができるので、再度の情報記録に使用することができる。

【００３８】

本発明の光センサーは、上述のように高分子分散型液晶を情報記録層とする情報記録媒体への情報記録に適しているが、他の情報記録媒体、例えば特開平４－７０８４２号公報、特開平４－４６３４７号公報、特開平３－７９４２号公報、特開平４－７３７６９号公報等に記載された、弗素樹脂等の電荷保持性に優れた絶縁性樹脂層を情報記録層とする静電情報記録媒体であって、情報を静電荷の形で蓄積し、トナー現像されるか、電位読み取りにより静電情報を再生することができる情報記録媒体や、また特開平３－１７０９８５号公報、特開平３－１７０９８４号公報、特開平３－１９２２８８号公報等に記載された、熱可塑性樹脂層を情報記録層とする情報記録媒体であって、上記同様に情報を静電荷の形で表面に蓄積した後、加熱されることにより、情報をフロスト像として蓄積し、可視情報として情報再生することが可能な情報記録媒体に対する情報記録にも使用できる。

また、本発明の光センサーは作製したままの状態では、本発明の特徴である半導電性を有さないため、本発明で使用することはできない。本発明で使用するためには、所定時間以上に放置することにより、暗所においても所定の半導電性を示すセンサーとなる。また、光センサーとしての使用前に十分な露光量の光を全面に一様露光した後使用しても良い。

【００３９】

本発明の光センサーは、露光強度が低い場合でも、電圧印加と露光の開始時点を変化させることにより、コントラストの充分な情報を記録することができる。また電圧印加と露光の開始時点により液晶記録層に印加される電位差が最大になる時間も異なるため、それぞれに応じて最適な印加電圧と電圧印加時間で情報記録を行うことができる。

また、本発明の光センサーは、露光後もしくは露光と同時に電圧印加した後に

電圧印加を停止し、再び電圧印加を行うか、逆極性の電圧を印加後に再び電圧を印加することにより露光部と未露光部で導電性に差が生じる。また、電圧印加を停止しているかもしくは逆極性の電圧を印加している間に、露光することにより再び電圧印加した際には、電圧印加をし続けた場合と同様に、露光部分の導電性が高くなっている。

【0040】

また、電圧印加を複数回行うことによりコントラストの大きな画像情報を記録することができる。１回目の電圧印加露光により、未露光部分の液晶記録媒体の電圧がしきい値になり、配向を開始した直後に電圧印加を停止するか、最初に印加した電圧より低い電圧または逆極性の電圧を印加することにより、液晶記録層の電圧を低くすることができる。この状態でしばらく経過した後に再び電圧印加し、未露光部の電圧がしきい値になるまで、電圧印加を続ける。電圧印加を停止した状態または逆極性の電圧が印加されている状態では、光センサーには逆極性の電圧が印加される場合もあるが、再び電圧が印加されることにより、未露光部分と露光部分の導電性に違いが生じるため、液晶記録層の露光部分により多くの電圧が印加されることになり情報記録をすることができる。

繰り返し電圧印加した場合の液晶記録層および光センサーに印加される電圧の変化の一例を図９に示す。ここでは、液晶記録媒体と光センサーは空気層を介して対向配置した例を示したが、光センサーと液晶記録媒体は直接もしくは誘電体層を介して積層したものであっても同様の電圧印加方法によって情報記録を行うことができる。

【0041】

また、光センサーに２種類以上の画像情報を多重露光して記録する方法について示す。図１０は、２つの画像情報を記録する方法について示す。電圧印加する前に、１つの画像情報をｔ１の期間露光し、もう一つの画像情報をｔ２の期間露光すると同時にｔ３の期間電圧印加し情報記録を行う。このような方法で２種類以上の画像情報を重ね合わせて１枚の画像を記録することができる。このように画像情報は液晶記録媒体の同じ場所に重ね合わせて記録することもできるし、それぞれの画像情報を別々の場所に記録することもできる。

一度の電圧印加で複数の画像情報を記録することで、２回目以降の画像を記録する際に、それ以前に記録した画像情報を乱すことなしに画像情報の記録を行うことができる。重ね合わせる画像情報の数に制限はないが、最初の画像情報を露光してからあまり長い間経過してから電圧印加をすると、画像情報が消滅していることがあるので、比較的短時間で画像記録を行う必要がある。

また、画像情報は時間とともに減衰するため、各画像情報を等しい強度で記録するためには、露光時間を調整する等の工夫が必要である。

【００４２】

レーザーで記録する場合には、光センサーにレーザー光を走査することにより画像や文字の情報を記録することができる。光センサーと液晶記録媒体を対向配置した状態でレーザー光を走査することにより、光センサー上に画像や文字情報を描画し、描画終了後、光センサーと液晶記録媒体には両電極間に電圧を印加することにより画像記録をすることができる。液晶記録媒体には、レーザー光を用いて熱により書き込むことができるが、熱による書き込みでは熱の拡散により高解像度の描画ができない問題があるが、このように光りセンサーに描画し、電圧印加して記録することにより高解像度の画像を記録することができる。

【００４３】

【作用】

電極上に光導電層を積層してなる光センサーと、電極上に電界または電荷により情報記録可能な情報記録層を積層してなる情報記録媒体とが対向させて配置され、情報光によって露光した後に光センサーの電極と情報記録媒体との電極間に電圧を印加するか、情報光を露光した状態で光センサーの電極と情報記録媒体との電極間の電圧印加を停止、もしくは逆極性の電圧の印加後に再度電圧の印加を行うようにしたので、未露光部と露光部の導電性の差が大きいので、弱い光による長時間露光によってもコントラストの大きな情報を記録することができる。

【００４４】

【実施例】

実施例１

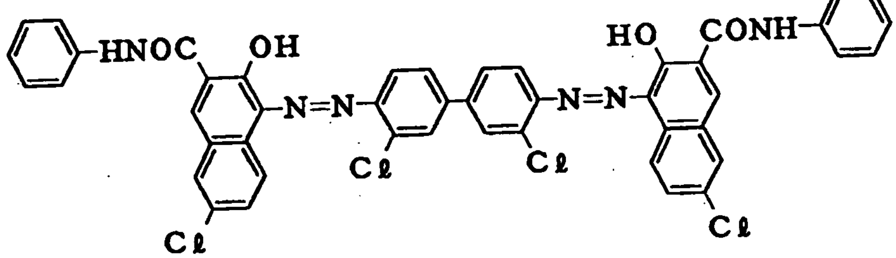
充分洗浄した厚さ１．１ｍｍのガラス基板上に、膜厚１００ｎｍのＩＴＯ膜を

スパッタリングにより成膜し電極層を得た。

その電極上に、下記構造を有するビスアゾ顔料３重量部、塩化ビニル－酢酸ビニル共重合体０．７５重量部、ポリ酢酸ビニル０．２５重量部、１．４－ジオキサン９８重量部、シクロヘキサノン９８重量部を混合しペイントシェーカーで６時間分散して塗布液とし、スピンナーにて１４００ｒｐｍ、０．４秒で塗布した後、１００℃、１時間乾燥して、膜厚３００ｎｍの電荷発生層を積層した。

【００４５】

【化１】

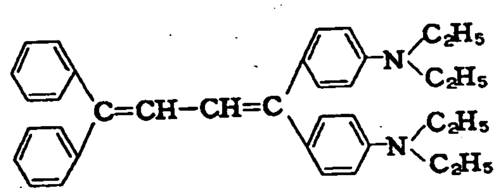


【００４６】

この電荷発生層上に、電荷輸送性物質として下記構造の化合物を１重量部、ポリスチレン樹脂を４重量部、１、１、２－トリクロロメタン２２重量部、ジクロロメタン１４重量部を混合した塗布液を、スピンナーにて４００ｒｐｍ、０．４秒間で塗布した後８０℃、２時間乾燥して電荷輸送層を積層し、電荷発生層と電荷輸送層からなる膜厚２０μｍの光導電層を有する光センサーを得た。得られた光センサーは作製後、相対湿度６０％以下の暗所下に３日間エージングしたのちに使用した。

【００４７】

【化２】



【００４８】

図１１に、本発明の光センサーの特性の測定方法を示す。光センサー１０は基

板１１上に透明電極１２を有し、透明電極上には電荷発生層と電荷輸送層からなる光導電層１３を有し、光導電層上には金電極３１を０．１６ｃm^2 の大きさで形成している。光源３２からフィルター３３を透過した緑色光はパルス発生装置３４によって開閉を制御されるシャッター３５から光センサー１０を照射する。また、パルス発生装置は金電極３１と透明電極間１２に直流電流を透明電極側が正になるように印加する電源３６の電圧および電圧印加時間を制御する。また、金電極側に結合した抵抗から電圧を取り出してオシロスコープ３７によって光電流を測定した。

【００４９】

露光強度２０ｌｕｘ、露光時間３３ｍ秒とし、露光開始と同時に２００Ｖの電圧を印加した場合の光センサーに流れる電流Ｌ１（明電流）と、露光しない場合の電流Ｌ２（暗電流）を図１２に示し、明電流と暗電流との差で表される光電流を図１３に示す。光電流は露光中は増加し、露光終了後も電圧印加中は緩やかに減衰し、充分長い時間流れ続ける。

【００５０】

次に、電圧印加と露光の開始時点をずらした場合に、明電流と暗電流を測定した結果を図１４に示す。露光時間、露光強度は図１２の場合と同様に、２０ｌｕｘ、３３ｍ秒間で、電圧印加は露光終了と同時に行い、２００Ｖの電圧を印加した。電圧印加開始前に、露光を終了した場合には、露光部分と未露光部分で導電性に違いがあることがわかる。

【００５１】

以上の２種類の電圧印加露光方法での電流測定したときの光電流の測定結果を図１５に示す。２０ｌｕｘの光を３３ｍ秒間露光し、一方は露光開始と同時に、２００Ｖの電圧を印加し（Ａ）、他方は露光終了と同時に２００Ｖの電圧を印加した（Ｂ）。明電流と暗電流の差で表される光電流は、露光と電圧印加の時点には関係なく、露光時間に依存し、電圧印加されている状態ではほぼ等しくなる。電圧印加開始は、露光開始と同時あるいは露光終了直後に行う必要はなく、露光中あるいは露光終了後しばらく時間が経過した後に電圧を印加しても同様の結果が得られる。

【００５２】

また、この例では光電流の値がほぼ等しくなる場合を示したが、必ずしも光電流が等しくなる場合のみではなく、露光と電圧印加時点により光電流が異なる場合もあるが、このような場合でも光照射終了後、電圧印加したときに、未露光部に対して露光部の導電性が高くなる光センサーは本発明の情報記録方法に使用することができる。

【００５３】

実施例２

電圧印加方法を以下のように変えた以外は実施例１と同様に光センサーの特性を測定した。

【００５４】

２００Ｖの一定電圧を印加した場合と、２００Ｖの矩形波電圧を印加した状態で２０ｌｕｘ、３３ｍ秒の光で露光した場合の電流の測定結果を図１６に示す。矩形波は、５０ｍ秒間の電圧の印加の後に５０ｍ秒間電圧の印加を停止した後に再び電圧を印加することを繰り返し行った。

【００５５】

一定電圧を印加した場合の電流を破線で示し、矩形波の電圧を印加した場合の電流を実線で示した。

【００５６】

電圧が印加されていない状態では、電流は流れないが、２００Ｖの電圧を印加した場合には、一定電圧を印加した場合も、矩形波のパルス状の電圧を印加した場合も電流はほぼ等しくなり、電圧印加を停止し、再び電圧を印加したときにも２００Ｖの電圧を印加し続けた場合とほぼ等しい電流値を示す。

【００５７】

また、パルス状の電圧を印加している間に電圧が印加されていない場合を示したが、逆極性の電圧が印加されている場合でも、上記と同様に２００Ｖの電圧が印加されている状態では、一定電圧を印加したときと等しい電流値になる。このとき逆極性の電圧が印加されている状態では、逆極性の電流が流れ、露光部分と未露光部分の導電性に違いはみられない。

【００５８】

以上のように、一定電圧を印加した場合とパルス状の電圧を印加した場合と測定される電流がほぼ等しくなる場合に限らず、露光中、露光終了後を問わず、露光部分と未露光部分の導電性が異なり、未露光部分に比べて露光部分の導電性が高くなっているような光センサーは本発明の情報記録方法に使用することができる。

【００５９】

実施例３

露光強度を１２１ｌｕｘ、露光時間を５００ｍ秒間とし、実施例２と同様に２００Ｖの一定電圧を連続的に印加した場合を破線で、５０ｍ秒間印加した後に５０ｍ秒間印加しない矩形波電圧を印加した場合を実線でそれぞれ図１７に示す。一定電圧を印加した状態では露光中は光電流が増加することは、これまでの実施例と同様であるが、矩形波電圧をパルス状に印加した場合には、印加電圧が０Ｖの期間も露光中は光電流が増加していることを示している。

【００６０】

実施例４

液晶記録媒体を情報記録媒体としたときの、光センサーの情報記録性能を求めた。液晶記録媒体は図１８に表すように、抵抗（R_{LC}）とコンデンサ（C_{LC}）の並列回路とし表現することができ、光センサーも抵抗（R_{PS}）とコンデンサ（C_{PS}）の並列回路として表現することができる。光センサーの膜厚１０μｍ、液晶記録媒体の１ｃm^2当りの容量：１０００ｐＦ、電気抵抗：１２０ＭΩ、光センサーと液晶記録媒体との間隔を１０μｍ、光センサー側の電極と液晶記録媒体側の電極の間の印加電圧を７３０Ｖとし、２０ｌｕｘ、１／３０秒間露光した場合の測定結果から求めた結果を図１９に示す。

電圧印加直後は、電圧は、光センサーと液晶記録媒体の容量の比に分配される。その後、光センサーと液晶記録媒体の抵抗成分により電圧の分配が変化し、液晶記録媒体の電圧が増加する。露光部分と未露光部分では光センサーの導電性が異なるため、未露光部分に比べて露光部分では液晶記録媒体により多くの電圧が印加されることとなる。

液晶記録媒体は、しきい値電圧以上になると、液晶が電界方向に配向し、透過率が増加する。その結果、未露光部分に比べて露光部分では液晶記録媒体の電圧が早くしきい値電圧に達するため、未露光部分の電圧がしきい値に到達し、配向を開始したときに電圧印加を停止すると、すでにしきい値以上の電圧が印加されて配向をした露光部分と未露光部分の透過率が異なり、電圧印加を停止した後もこの状態が維持されるために情報を記録することができる。

【００６１】

実施例５

６ｌｕｘの強度の光を２００ｍ秒間露光した後に、露光終了と同時に２００Ｖの電圧を印加した点を除いて実施例２と同様に、明電流と暗電流の差である光電流を測定し、その結果を図２０に示す。また、液晶記録媒体への情報記録に有効な電圧印加開始後５０ｍ秒間の光電流を斜線で示す。

【００６２】

実施例６

６ｌｕｘの強度の光を２００ｍ秒間露光し、露光開始後１５０ｍ秒後に２００Ｖの電圧を印加した点を除いて実施例５と同様に、明電流と暗電流の差である光電流を測定し、その結果を図２１に示す。また、液晶記録媒体への情報記録に有効な電圧印加開始後５０ｍ秒間の光電流を斜線で示す。

【００６３】

比較例１

６ｌｕｘの強度の光を２００ｍ秒間露光し、露光と同時に２００Ｖの電圧を印加した点を除いて実施例５と同様に、明電流と暗電流の差である光電流を測定し、その結果を図２２に示す。また、液晶記録媒体への情報記録に有効な電圧印加開始後５０ｍ秒間の光電流を斜線で示す。

長時間の露光によって２０ｌｕｘの光を３３ｍ秒間露光した場合と同等の光電流を得ることができるが、電圧印加開始後５０ｍ秒間の光電流を斜線で示すように斜線の部分の面積が、２０ｌｕｘの光を露光した場合や実施例５あるいは６に比べて少なく、充分なコントラストの画像の情報記録ができないことを示している。

【００６４】

実施例７

実施例４と同様に液晶記録媒体に印加される電圧を計算し、露光部と未露光部に電圧の差をシミュレーションした結果を図２３に示す。図において、ａは２０ｌｕｘ、３３ｍ秒間露光し、露光と同時に電圧を印加した場合、ｂは比較例１、ｃは実施例５、ｄは実施例６を示し、ｅは６１ｕｘで２００ｍ秒間露光した場合で、露光開始後１７５ｍ秒後に電圧印加した場合をそれぞれ示している。

液晶記録媒体のしきい値電圧を２００Ｖとすると、未露光部の液晶記録媒体の電圧は約６５ｍ秒後でしきい値電圧に達するために、この時間内に電圧印加を停止することによって情報を記録することができる。この場合の明部と暗部の電位差を比較することによって情報記録後のコントラストを推定することができる。図２３から、６５ｍ秒後における電位差を比較すると、ａに比べてｂの電位差は１／２程度であるため、大きなコントラストが得られないことがわかる。これに対して、ｃ、ｄ、ｅではａと同程度かそれ以上の電位差が得られる。また、ｄ，ｅは６５ｍ秒後には、同程度の電位差だが、ｄに比べてｅの印加電圧を高めに設定して、３０ｍ秒程度の電圧印加時間で情報記録を行うことにより、より大きなコントラストで情報記録を行うことができる。

【００６５】

【発明の効果】

本発明の光センサーは、情報光の露光の後に、光センサーの電極と情報記録媒体との電極間に電圧を印加するか、情報光を露光した状態で光センサーの電極と情報記録媒体との電極間に印加する電圧を断続化、あるいは電圧の印加を停止した後に再度電圧の印加を行うようにしたので、未露光部と露光部の導電性の差が大きいので、液晶によって記録する場合にも未露光部の電圧が液晶のしきい値電圧以上には上昇しないので、弱い光による長時間露光によってもコントラストの大きな情報を記録することができる。

【図面の簡単な説明】

【図１】

電圧の印加と露光を同時に行う光センサー電流測定結果を示す図である。

【図２】

液晶とそれを保持する樹脂からなる情報記録媒体をコンデンサと抵抗の並列回路とした時の液晶記録層に印加される電圧を露光部と未露光部についてのシミュレーションの結果を示す図である。

【図３】

２００Ｖの電圧を印加した状態で６１ｕｘの光を２００ｍ秒間露光したときの電流値を測定した結果である。

【図４】

６１ｕｘで露光したときの露光部分と未露光部分の電流値の差を示す図である。

【図５】

２０１ｕｘで露光したときの露光部分と未露光部分の電流値の差を示す図である。

【図６】

光センサーを説明するための断面図である。

【図７】

本発明の方法に使用する情報記録装置を説明する断面図である。

【図８】

本発明の情報記録装置への情報記録方法について説明する図である。

【図９】

繰り返し電圧印加した場合の液晶記録層および光センサーに印加される電圧の変化の一例を説明する図である。

【図１０】

多重露光による画像情報を記録する方法を説明する図である。

【図１１】

本発明の光センサーの特性の測定方法を説明する図である。

【図１２】

光センサーの電気的特性を説明する図である。

【図１３】

明電流と暗電流との差で表される光電流を説明する図である。

【図１４】

電圧印加と露光の開始時点をずらした場合に、明電流と暗電流を測定した結果を説明する図である。

【図１５】

異なる電圧印加露光方法での電流測定したときの光電流の測定結果を説明する図である。

【図１６】

一定電圧を印加した場合と矩形波電圧を印加した状態で露光した場合の光電流の測定結果を説明する図である。

【図１７】

一定電圧を印加した場合と矩形波電圧を印加した状態で露光した場合の他の例の光電流の測定結果を説明する図である。

【図１８】

液晶記録媒体の等価回路を説明する図である。

【図１９】

光センサーの情報記録性能を説明する図である。

【図２０】

露光終了後に電圧を印加した場合の光電流の測定結果を説明する図である。

【図２１】

露光終了後に電圧を印加した場合の光電流の他の測定結果を説明する図である。

【図２２】

露光終了後に電圧を印加した場合の光電流の他の測定結果を説明する図である。

【図２３】

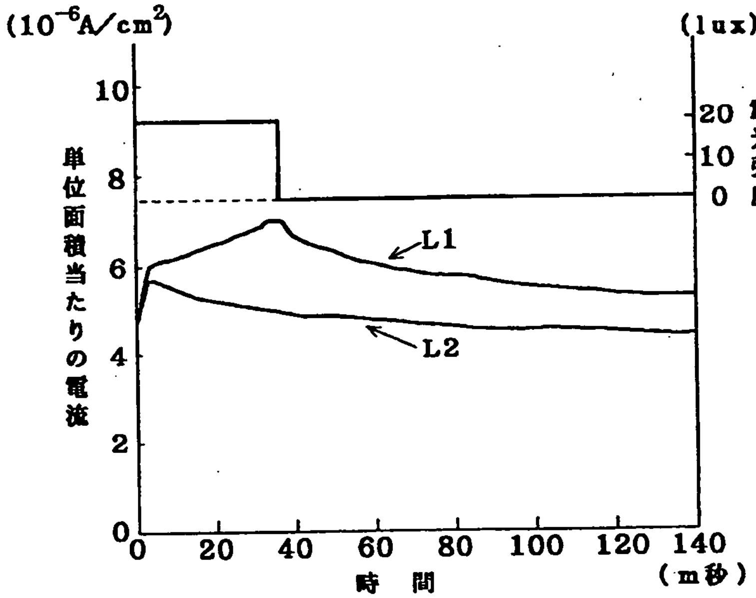
露光部と未露光部に電圧の差をシミュレーションした結果を説明する図である。

【符号の説明】

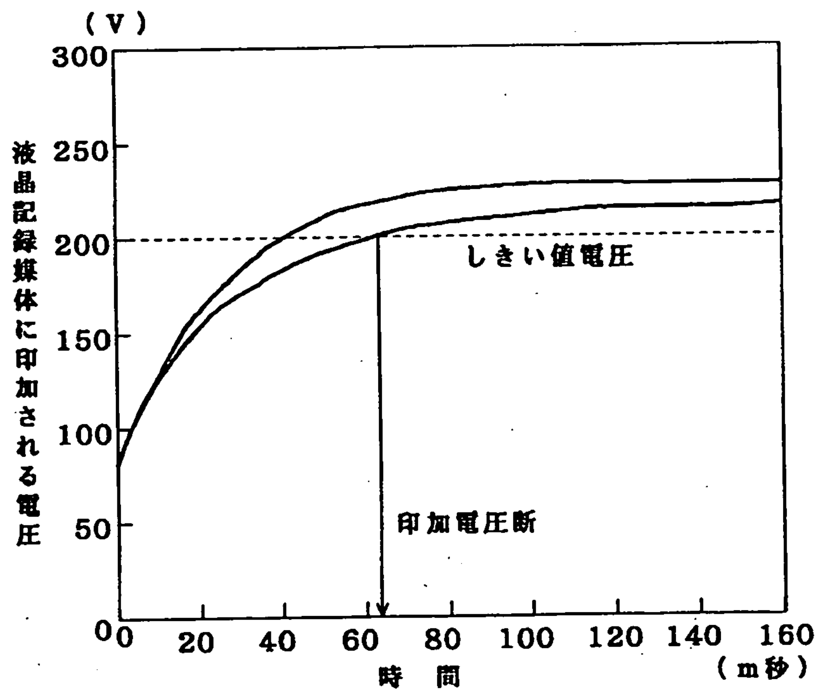
１０…光センサー、１１…基板、１２…電極、１３…光導電層、１４…電荷発生層、１５…電荷輸送層、１６…スペーサ、１７…情報光、１８…制御装置、２０…情報記録媒体、２１…基板、２２…電極、２３…情報記録層、３１…金電極、３２…光源、３３…フィルター、３４…パルス発生装置、３５…シャッター、３６…電源、３７…オシロスコープ

【書類名】　図面

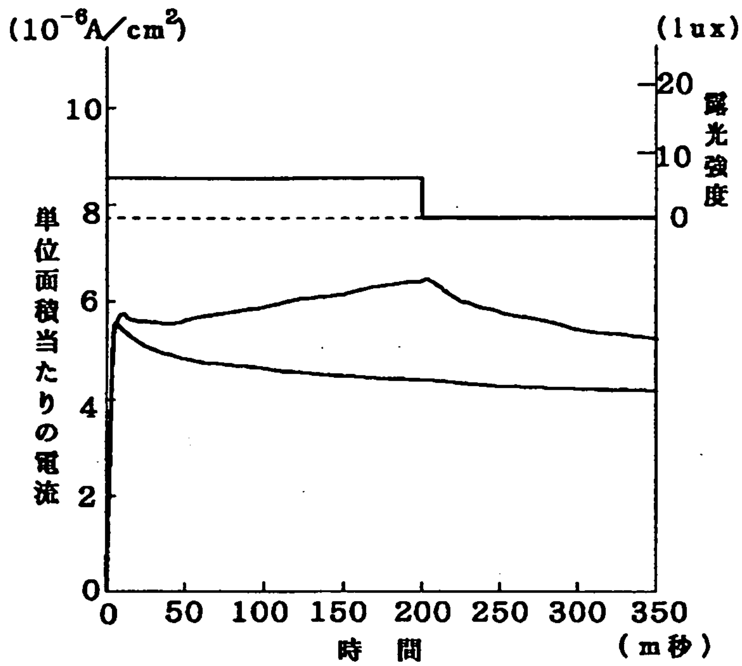
【図１】


(10^-6A/cm^2)
(lux)
単位面積当たりの電流
露光強度
L1
L2
時　間
(m秒)

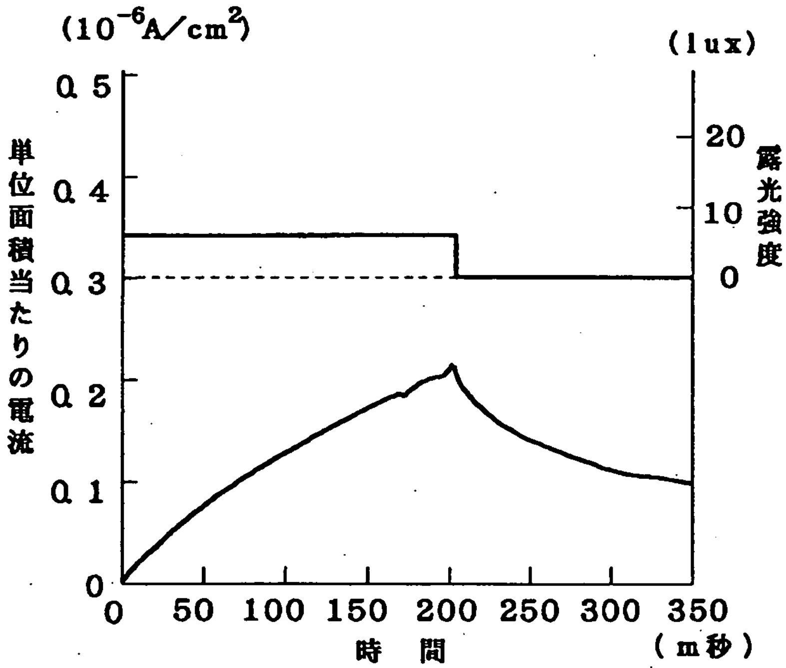
【図２】


(V)
液晶記録媒体に印加される電圧
しきい値電圧
印加電圧断
時　間
(m秒)

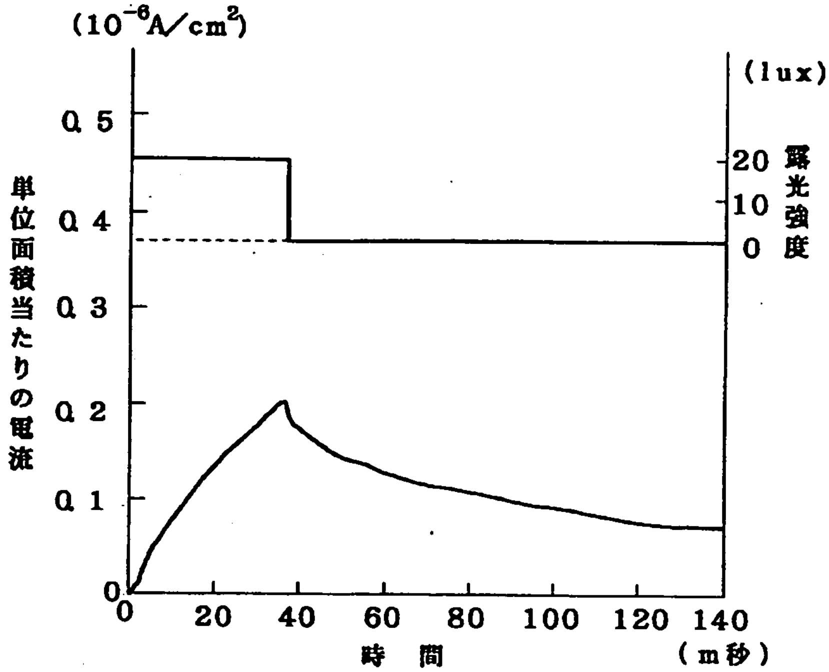
【図3】


(10^-6A/cm²)
(lux)
10
8
6
4
2
0
単位面積当たりの電流
20
10
0
露光強度
0 50 100 150 200 250 300 350
時　間
(m秒)

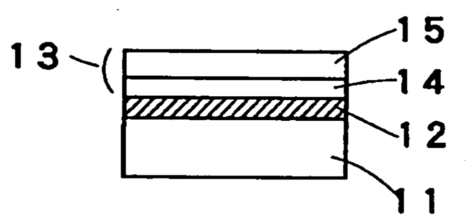
【図4】


(10^-6A/cm²)
(lux)
0.5
0.4
0.3
0.2
0.1
0
単位面積当たりの電流
20
10
0
露光強度
0 50 100 150 200 250 300 350
時　間
(m秒)

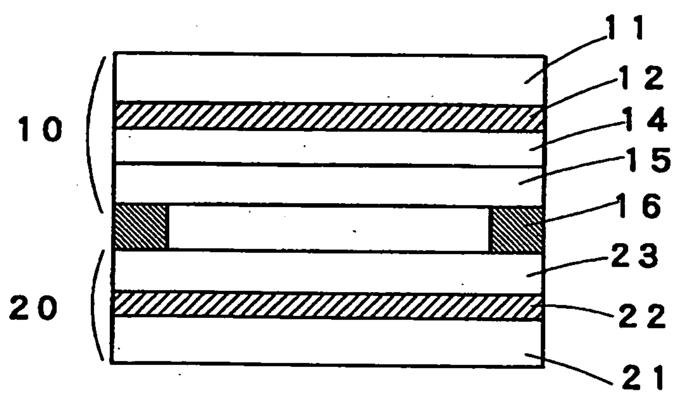
【図5】


(10⁻⁶A/cm²)
(lux)
0.5
0.4
0.3
0.2
0.1
0
単位面積当たりの電流
20
10
0
露光強度
0
20
40
60
80
100
120
140
時　間
(m秒)

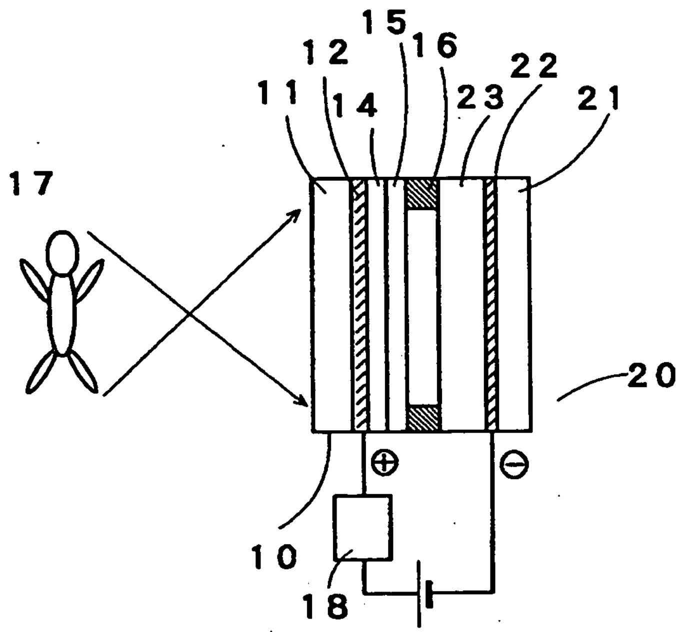
【図6】


13
15
14
12
11

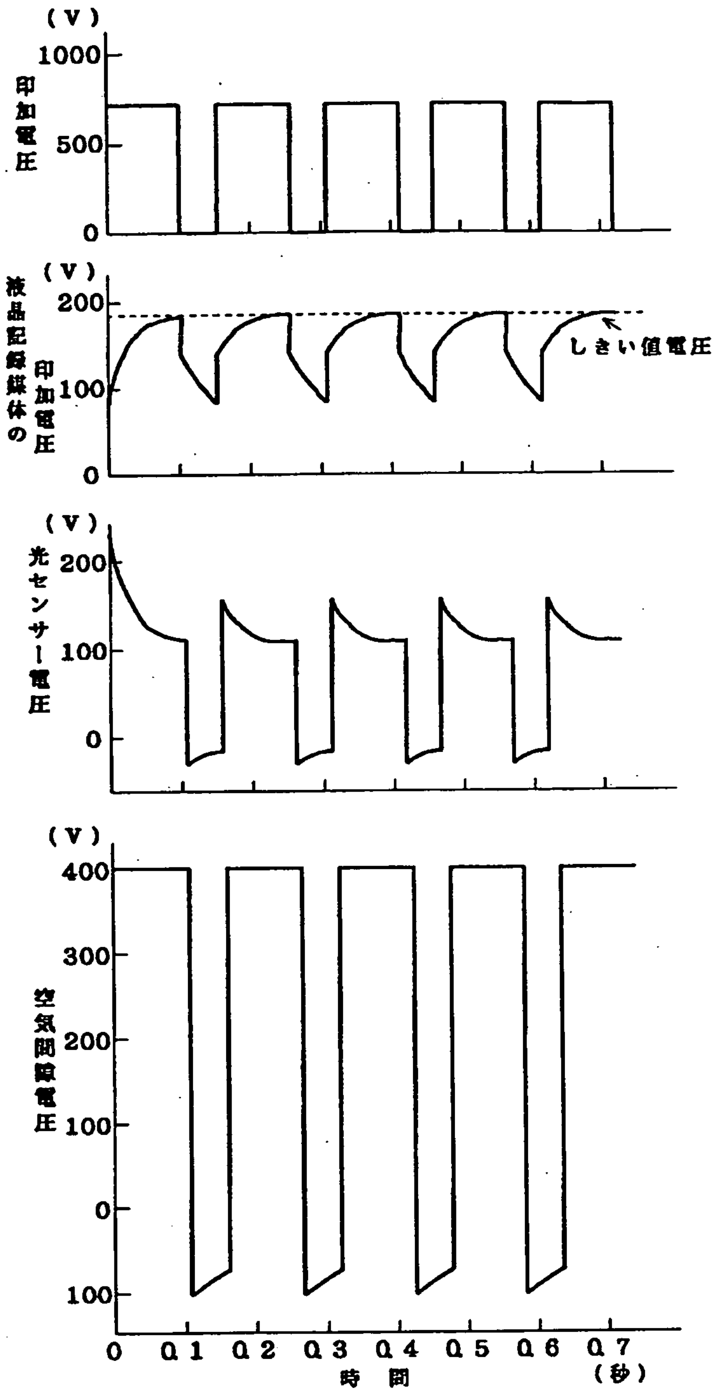
【図7】


10
20
11
12
14
15
16
23
22
21

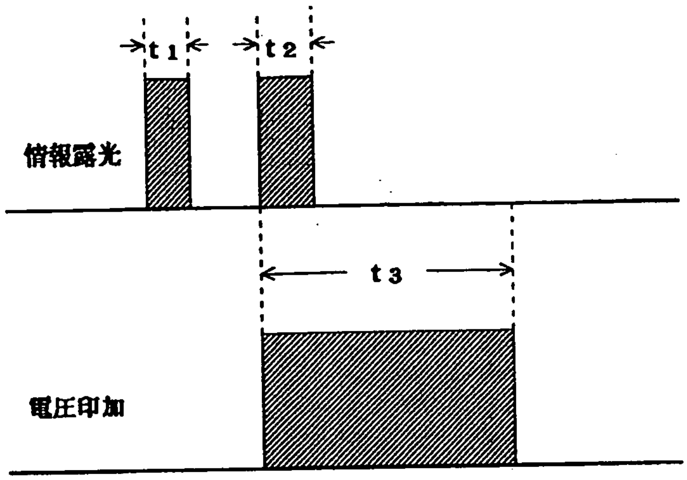
【図８】



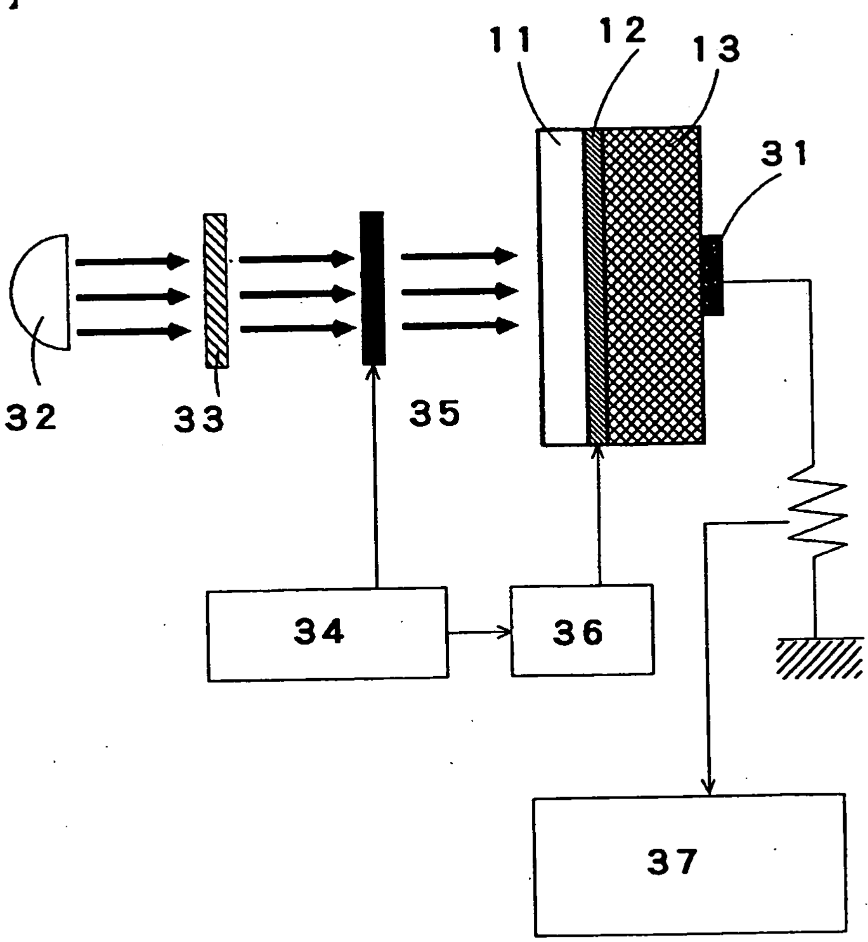
【図9】


(V)
1000
印加電圧
500
0
(V)
200
液晶記録媒体の印加電圧
100
0
しきい値電圧
(V)
光センサー電圧
200
100
0
(V)
400
300
空気間隙電圧
200
100
0
100
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
(秒)
時間

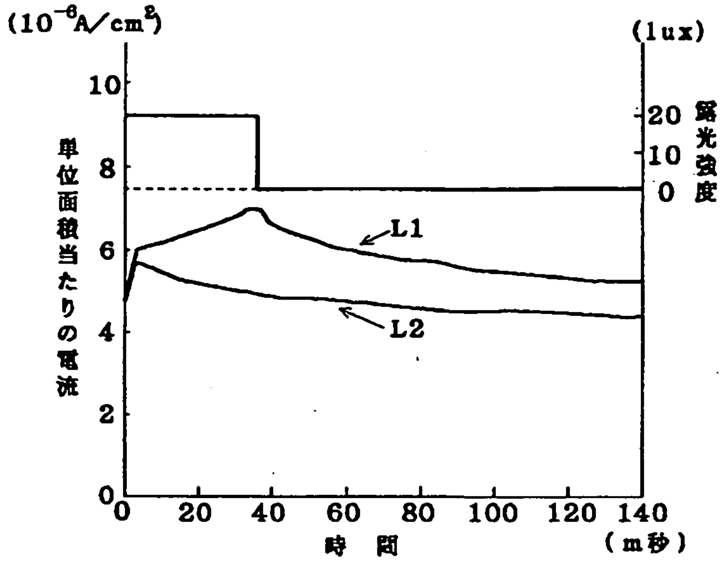
【図１０】



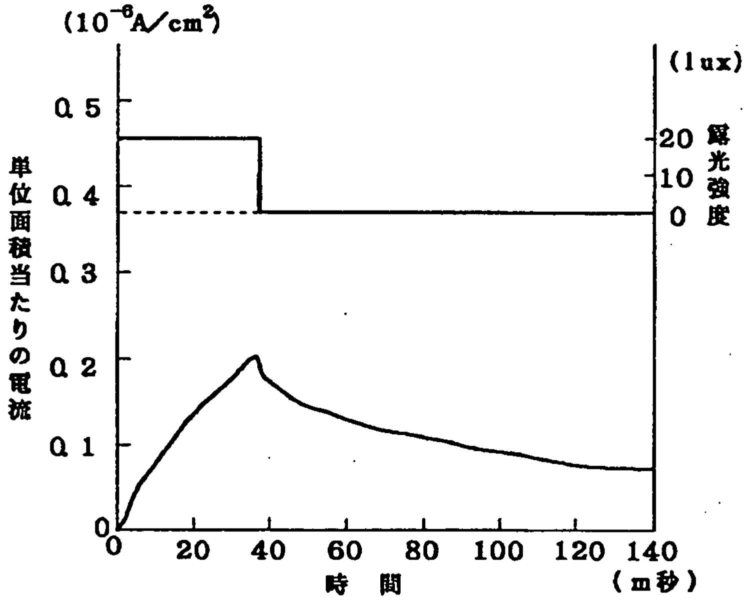
【図１１】



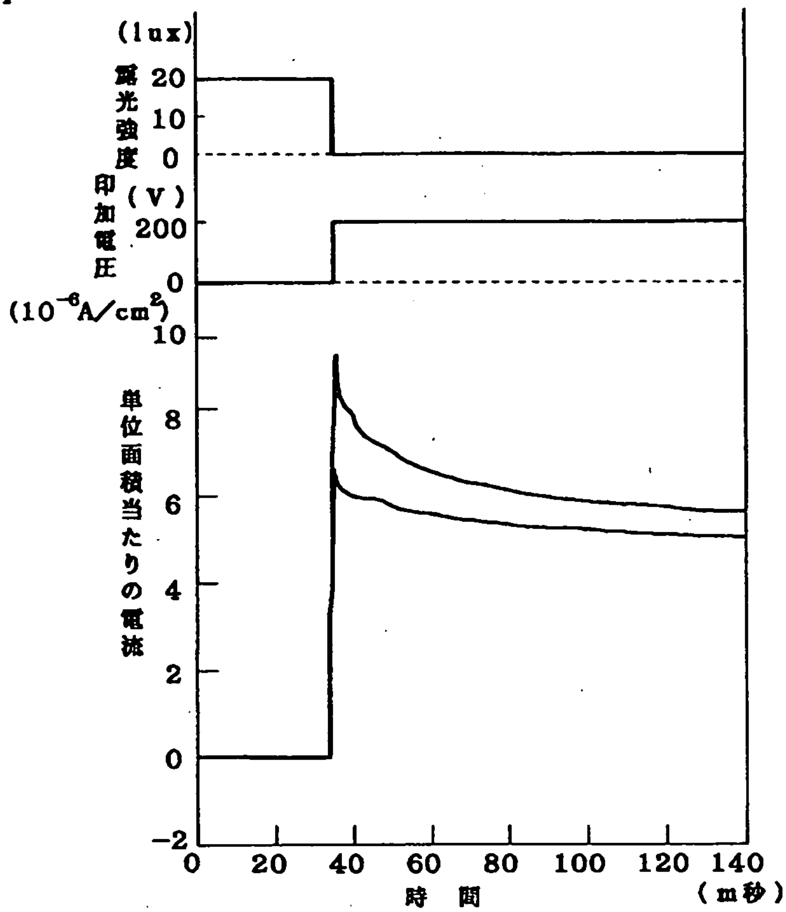
【図１２】


(10⁻⁶A/cm²)
(lux)
単位面積当たりの電流
露光強度
10
8
6
4
2
0
20
10
0
L1
L2
0
20
40
60
80
100
120
140
時間
(m秒)

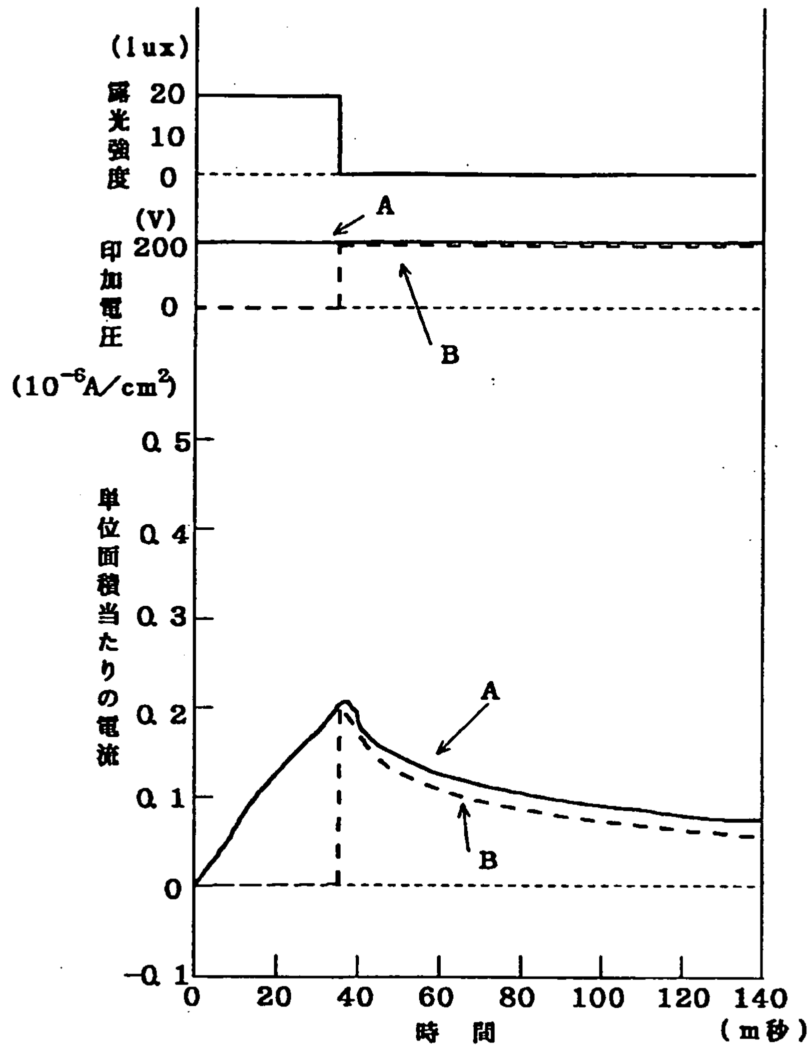
【図１３】


(10⁻⁶A/cm²)
(lux)
単位面積当たりの電流
露光強度
0.5
0.4
0.3
0.2
0.1
0
20
10
0
0
20
40
60
80
100
120
140
時間
(m秒)

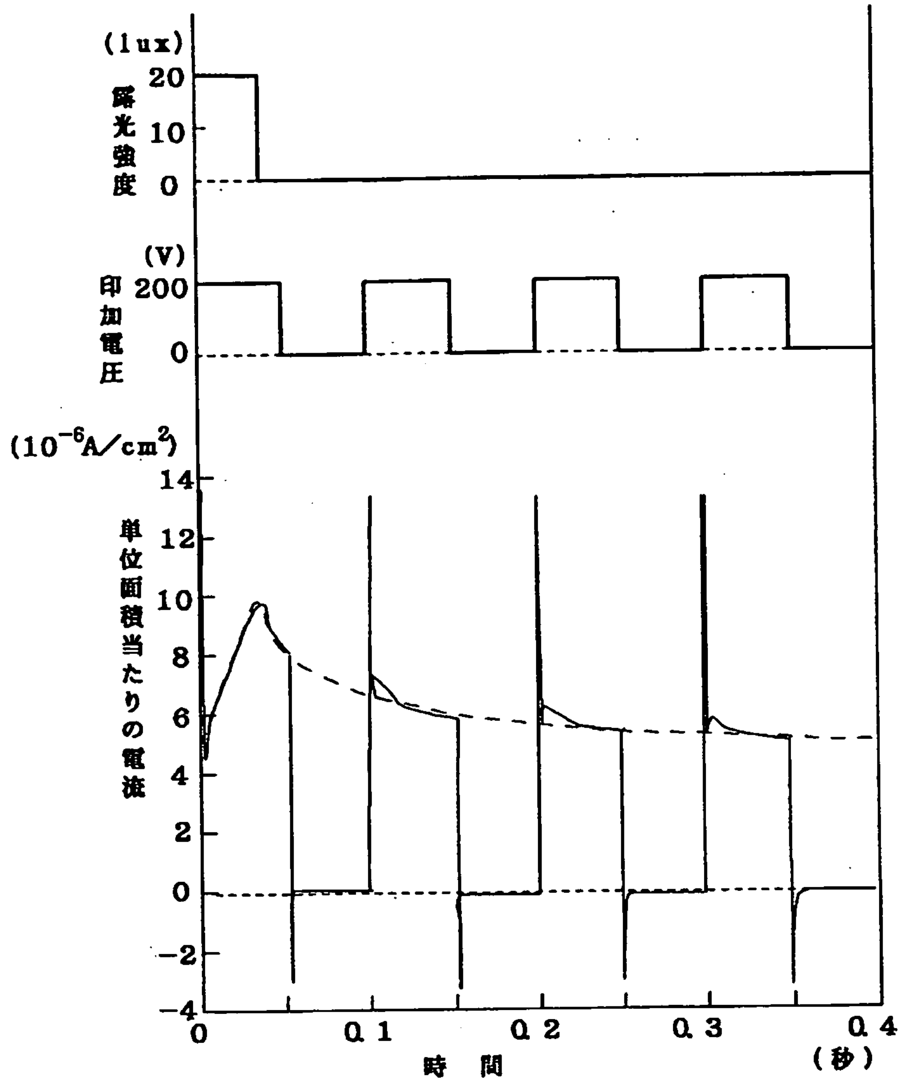
【図１４】


(lux)
露光強度
20
10
0
印加電圧
(V)
200
0
(10^{-6}A/cm^2)
単位面積当たりの電流
10
8
6
4
2
0
−2
0
20
40
60
80
100
120
140
時　間
(m秒)

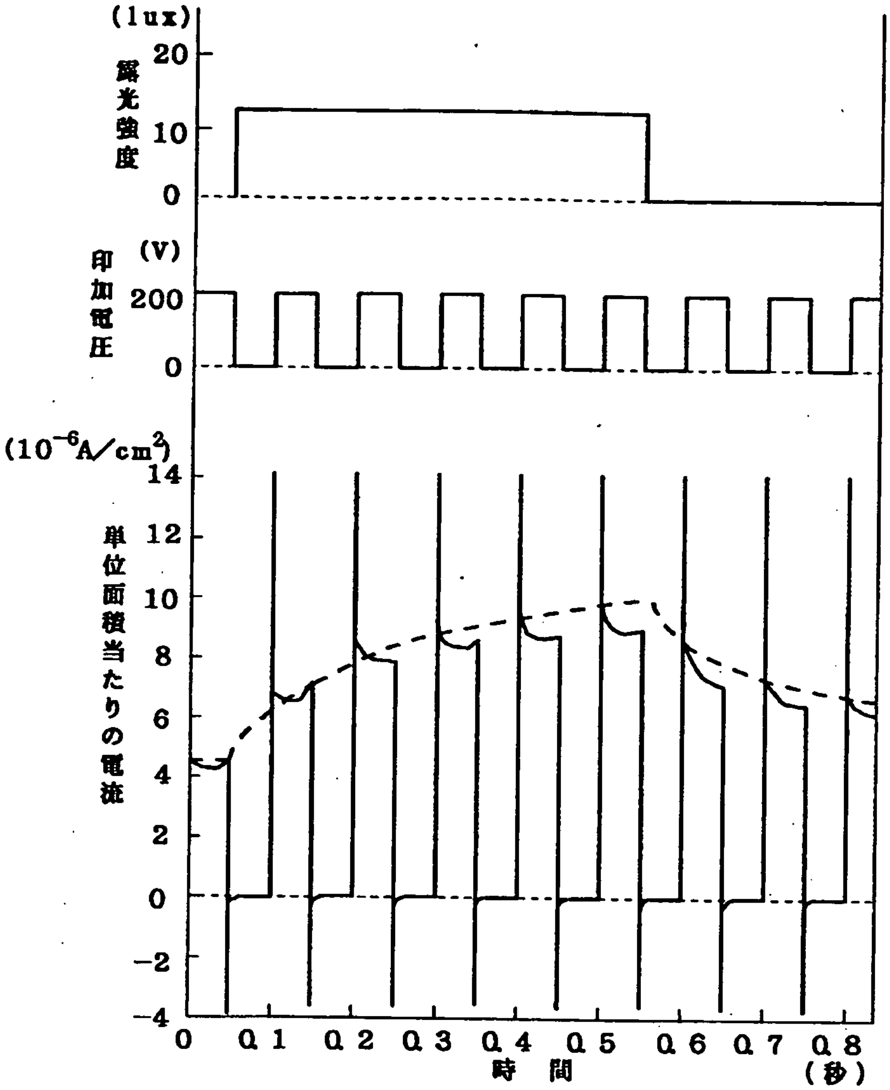
【図１５】


(lux)
露光強度
20
10
0
(V)
印加電圧
200
0
A
B
(10^{-6}A/cm^2)
単位面積当たりの電流
0.5
0.4
0.3
0.2
0.1
0
−0.1
A
B
0
20
40
60
80
100
120
140
時　間
(m秒)

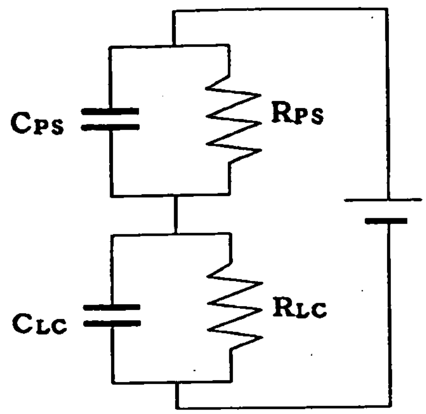
【図１６】


(lux)
20
10
0
露光強度
(V)
200
0
印加電圧
(10^-6A/cm^2)
14
12
10
8
6
4
2
0
−2
−4
単位面積当たりの電流
0
0.1
0.2
0.3
0.4
(秒)
時　間

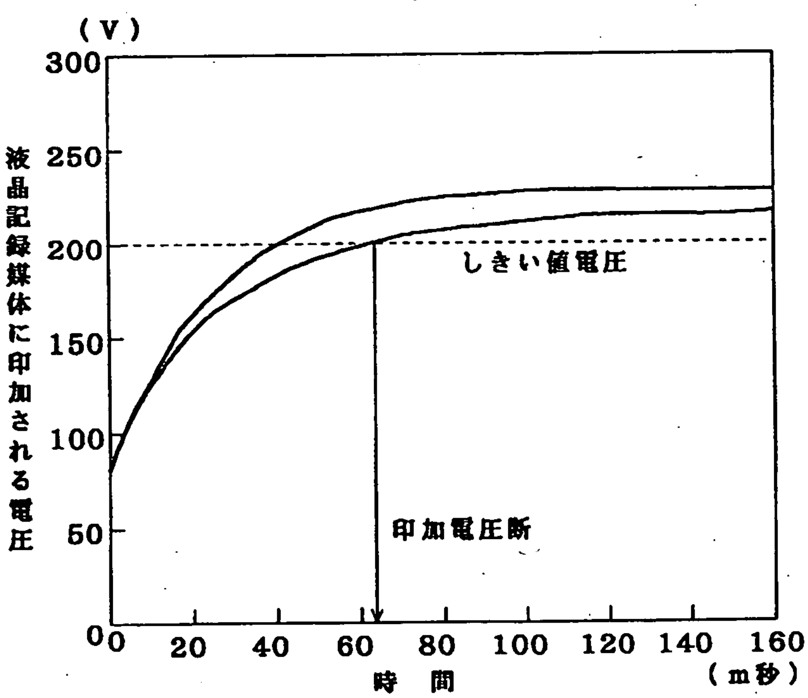
【図１７】


(lux)
露光強度
20
10
0
(V)
印加電圧
200
0
(10^-6A/cm^2)
単位面積当たりの電流
14
12
10
8
6
4
2
0
−2
−4
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
時　間
(秒)

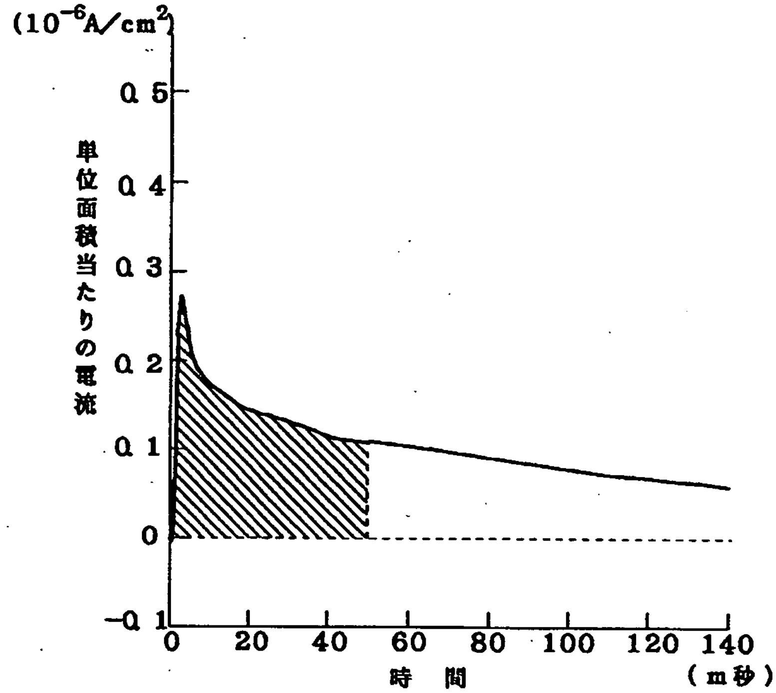
【図１８】


CPS
RPS
CLC
RLC

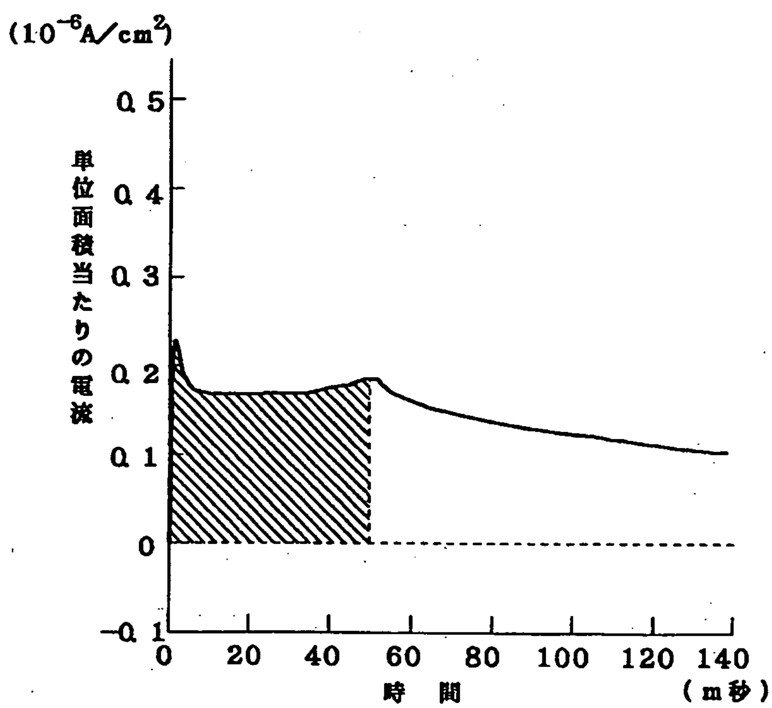
【図１９】


(V)
300
250
200
150
100
50
0
液晶記録媒体に印加される電圧
しきい値電圧
印加電圧断
0
20
40
60
80
100
120
140
160
時　間
(m秒)

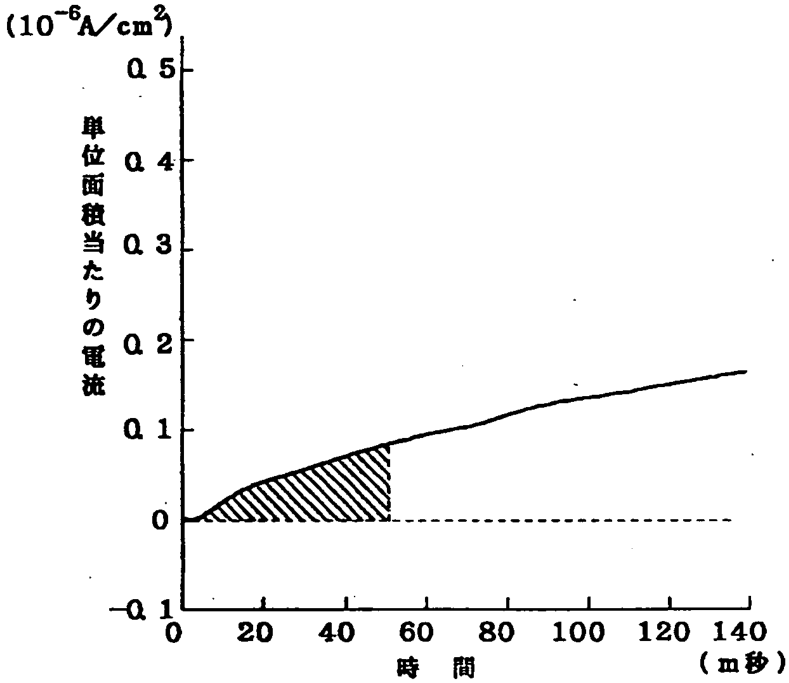
【図２０】


(10^{-6}A/cm^2)
0.5
0.4
0.3
0.2
0.1
0
−0.1
単位面積当たりの電流
0
20
40
60
80
100
120
140
時　間
（ｍ秒）

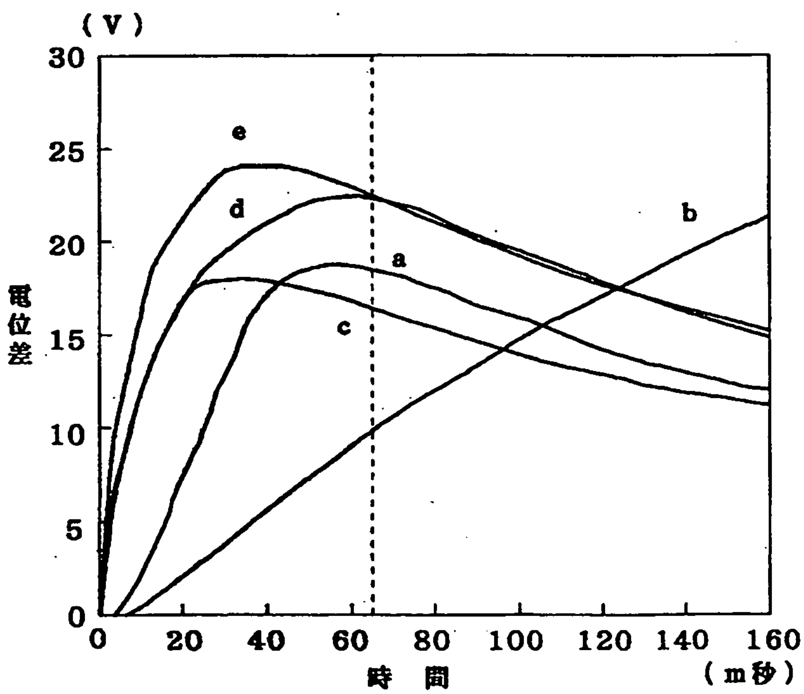
【図２１】


(10^{-6}A/cm^2)
0.5
0.4
0.3
0.2
0.1
0
−0.1
単位面積当たりの電流
0
20
40
60
80
100
120
140
時　間
（ｍ秒）

【図22】


(10^{-6}A/cm^2)
単位面積当たりの電流
0.5
0.4
0.3
0.2
0.1
0
-0.1
0
20
40
60
80
100
120
140
時　間
(m秒)

【図23】


(V)
30
25
20
15
10
5
0
電位差
e
d
a
c
b
0
20
40
60
80
100
120
140
160
時　間
(m秒)

【書類名】　要約書

【要約】

【目的】　弱い光でもコントラストの大きな情報記録が可能な光センサーを得る。

【構成】　電極上に光導電層を有し、情報記録媒体への情報形成に使用される光センサーにおいて、光センサーの電極と情報記録媒体の電極の間に、電圧を印加しない状態または逆極性の電圧を印加した状態で露光した後、光センサーの電極と情報記録媒体の電極の間に電圧を印加、もしくは情報露光した状態で、電圧印加を停止し、または逆極性の電圧を印加した後、再びもとの電圧を印加することにより電圧を印加し続けた場合と導電性が等しくなる光センサーによって液晶等の情報記録媒体に記録する。

【効果】　未露光部と露光部のコントラストが大きな光センサーが得られる。

【選択図】　図１６

【書類名】　職権訂正データ
【訂正書類】　特許願

＜認定情報・付加情報＞
【特許出願人】
【識別番号】　000002897
【住所又は居所】　東京都新宿区市谷加賀町一丁目１番１号
【氏名又は名称】　大日本印刷株式会社
【代理人】　申請人
【識別番号】　100091971
【住所又は居所】　東京都台東区上野１丁目１０番１０号　うさぎやビル４階　梓特許事務所
【氏名又は名称】　米澤　明
【選任した代理人】
【識別番号】　100088041
【住所又は居所】　東京都台東区上野１丁目１０番１０号　うさぎやビル４階　梓特許事務所
【氏名又は名称】　阿部　龍吉
【選任した代理人】
【識別番号】　100092495
【住所又は居所】　東京都台東区上野１丁目１０番１０号　うさぎやビル４階　梓特許事務所
【氏名又は名称】　蛭川　昌信
【選任した代理人】
【識別番号】　100092509
【住所又は居所】　東京都台東区上野１丁目１０番１０号　うさぎやビル４階　梓特許事務所
【氏名又は名称】　白井　博樹
【選任した代理人】
【識別番号】　100095120
【住所又は居所】　東京都台東区上野１丁目１０番１０号　うさぎやビル４階　梓特許事務所
【氏名又は名称】　内田　亘彦
【選任した代理人】
【識別番号】　100095980
【住所又は居所】　東京都台東区上野１丁目１０番１０号　うさぎやビル４階　梓特許事務所
【氏名又は名称】　菅井　英雄
【選任した代理人】

【識別番号】　100094787
【住所又は居所】　東京都台東区上野１丁目１０番１０号　うさぎやビル４階　梓特許事務所
【氏名又は名称】　青木　健二
【選任した代理人】
【識別番号】　100097777
【住所又は居所】　東京都台東区上野１丁目１０番１０号　うさぎやビル４階　梓特許事務所
【氏名又は名称】　韮澤　弘

出　願　人　履　歴　情　報

識別番号　〔０００００２８９７〕

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　［変更理由］　新規登録
　　住　所　東京都新宿区市谷加賀町一丁目１番１号
　　氏　名　大日本印刷株式会社

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【発明者】

　【住所又は居所】　東京都新宿区市谷加賀町一丁目１番１号大日本印刷株式会社内

　【氏名】　岡部将人

【特許出願人】

　【識別番号】　000002897

　【氏名又は名称】　大日本印刷株式会社

　【代表者】　北島義俊

【代理人】

　【識別番号】　100092495

　【弁理士】

　【氏名又は名称】　蛭川昌信

　【選任した代理人】

　　【識別番号】　100088041

　　【弁理士】

　　【氏名又は名称】　阿部龍吉

　【選任した代理人】

　　【識別番号】　100092509

　　【弁理士】

　　【氏名又は名称】　白井博樹

　【選任した代理人】

　　【識別番号】　100095120

【弁理士】

【氏名又は名称】　内田亘彦

【選任した代理人】

【識別番号】　100095980

【弁理士】

【氏名又は名称】　菅井英雄

【選任した代理人】

【識別番号】　100094787

【弁理士】

【氏名又は名称】　青木健二

【選任した代理人】

【識別番号】　100097777

【弁理士】

【氏名又は名称】　韮澤　弘

【選任した代理人】

【識別番号】　100091971

【弁理士】

【氏名又は名称】　米澤　明

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【発明の名称】　光センサ、情報記録方法及び装置

【特許請求の範囲】

【請求項１】　電極上に光導電層を有し、情報記録媒体への情報形成に使用される光センサにおいて、光センサに電圧を印加しない状態、または逆極性の電圧を印加した状態で、露光した後に電圧印加したときに、露光量に応じて光誘起電流が発生し、情報記録が可能であることを特徴とする光センサ。

【請求項２】　電極上に光導電層を有し、情報記録媒体への情報形成に使用される光センサにおいて、電圧を印加した状態で情報露光することによって露光部の導電性が未露光部の導電性よりも増加し、情報露光終了後も露光した部分の導電性が、未露光部分の導電性よりも高く、さらに情報露光した状態、または情報露光終了後に、電圧印加を停止、または逆極性の電圧を印加した後、再びもとの電圧を印加することにより、電圧を印加し続けた場合と導電性が等しくなることを特徴とする光センサ。

【請求項３】　光センサへの10^5～10^6V／cm^2の電界の印加時に、未露光部での通過電流密度が10^{-4}～10^{-7}A／cm^2である請求項１または２記載の光センサ。

【請求項４】　情報露光によって情報記録媒体へ光情報を記録する情報記録方法において、請求項１または３記載の光センサと電極上に情報記録層を形成した情報記録媒体を使用し、光センサもしくは情報記録媒体の少なくともいずれか一方の電極を透明電極とするとともに、光センサと情報記録媒体を間隙を設けて光軸上に対向配置するか、または、光センサと情報記録媒体を直接または誘電体中間層を介して積層し、光情報の露光を行った後に、または光情報の露光中に両電極間に電圧印加を開始することを特徴とする情報記録方法。

【請求項５】　請求項４記載の方法において、前記情報記録媒体が、電極上に、液晶と樹脂からなる高分子－液晶複合体層を形成した液晶記録媒体であることを特徴とする情報記録方法。

【請求項６】　請求項５記載の方法において、光情報の露光終了から一定時間経過後に電圧印加を開始することにより、記録する画像のラチチュードを広げ

ることを特徴とする情報記録方法。

【請求項７】　請求項６記載の方法において、光情報の露光終了から電圧印加開始までの時間が０～５００ｍｓｅｃであることを特徴とする情報記録方法。

【請求項８】　情報露光によって情報記録媒体へ光情報を記録する情報記録再生方法において、請求項２または３に記載の光センサと電極上に情報記録層を形成した情報記録媒体を使用し、光センサもしくは情報記録媒体の少なくともいずれか一方の電極を透明電極とするとともに、光センサと情報記録媒体を間隙を設けて光軸上に対向配置するか、または、光センサと情報記録媒体を直接または誘電体中間層を介して積層し、光情報の露光を行うとともに、光情報の露光を行っている間、または光情報の露光終了後に、電圧を印加しない期間もしくは逆極性の電圧を印加する期間を設けることを特徴とする情報記録方法。

【請求項９】　請求項８記載の情報記録方法において、前記情報記録媒体が、電極上に、液晶と樹脂からなる高分子一液晶複合体層を形成した液晶記録媒体であることを特徴とする情報記録方法。

【請求項１０】　情報露光によって情報記録媒体へ光情報を記録する情報記録方法において、光センサと、電極上に情報記録層を形成した情報記録媒体を使用し、光センサもしくは情報記録媒体の少なくともいずれか一方の電極を透明電極とするとともに、光センサと情報記録媒体を間隙を設けて光軸上に対向配置するか、または、光センサと情報記録媒体を直接または誘電体中間層を介して積層し、光センサに情報露光し、光センサと情報記録媒体の両電極間に電圧印加して情報記録する方法において、シャッター速度に応じて、適切な画像露光と電圧印加方法を測定し、広い範囲で相反則が成り立つようにしたことを特徴とする情報記録方法。

【請求項１１】　請求項１０記載の情報記録方法において、前記情報記録媒体が、電極上に、液晶と樹脂からなる高分子一液晶複合体層を形成した液晶記録媒体であることを特徴とする情報記録方法。

【請求項１２】　請求項１１記載の情報記録方法において、予め測定しておいたシャッター速度と記録特性の関係を基に、絞り又は露光時間を補正することで広い範囲で相反則が成り立つようにしたことを特徴とする情報記録方法。

【請求項１３】　請求項１１記載の情報記録方法において、請求項１または３記載の光センサを使用し、電圧印加開始前に画像露光を開始することにより、相反則不軌を補正することを特徴とする情報記録方法。

【請求項１４】　請求項１１記載の情報記録方法において、請求項２または３記載の光センサを使用し、画像露光中または画像露光終了後に、電圧印加しない期間もしくは逆極性の電圧を印加する期間を設けることにより、相反則不軌を補正することを特徴とする情報記録方法。

【請求項１５】　請求項１１記載の情報記録方法において、請求項１または３記載の光センサを使用し、画像露光終了後、一定時間経過後に電圧印加を開始することにより、相反則不軌を補正することを特徴とする情報記録方法。

【請求項１６】　請求項１１記載の情報記録方法において、印加電圧および／または電圧印加時間を制御することにより相反則不軌を補正することを特徴とする画像情報記録方法。

【請求項１７】　情報露光によって情報記録媒体へ光情報を記録する情報記録装置において、光センサと電極上に情報記録層を形成した情報記録媒体を使用し、光センサもしくは情報記録媒体の少なくともいずれか一方の電極を透明電極とするとともに、光センサと情報記録媒体を間隙を設けて光軸上に対向配置するか、または、光センサと情報記録媒体を直接または誘電体中間層を介して積層し、光情報の露光を行った後に、または光情報の露光中に両電極間に電圧印加を開始する機構を設けたことを特徴とする情報記録装置。

【請求項１８】　透明電極上に光導電層を積層した光センサと、電極上に情報記録層を積層した情報記録媒体を空隙を介して光軸上に対向配置するか、または、光センサの光導電層上に直接または誘電体中間層を介して情報記録層を積層し、さらに上部電極を形成した一体型媒体において光センサに画像露光し、両電極間に電圧印加することにより、露光量に応じて画像情報等を記録する装置において、露光強度を測光し、露光時間を算出する手段を有し、および／または露光時間を入力する手段を有し、露光時間の広い範囲で相反則が成り立つように、露光時間に応じて適切な条件でシャッターと電源を制御する機能を有することを特徴とする情報記録装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】

本発明は、情報記録媒体への光情報を可視情報または静電情報の形で記録することができる光センサと情報記録媒体からなる情報記録システムに関し、特に情報記録媒体への情報記録性能が著しく増幅される光導電層を有する光センサ、情報記録方法、及び情報記録装置に関する。

【０００２】

【従来の技術】

前面に電極が設けられた光導電層からなる光センサと、該光センサに対向し、後面に電極が設けられた電荷保持層からなる情報記録媒体とを光軸上に配置し、両導電層間に電圧を印加しつつ露光し、入射光学像に応じて、電荷保持層に静電電荷を記録させ、その静電電荷をトナー現像するかまたは電位読み取りにより再生する方法は、例えば特開平１－２９０３６６号公報、特開平１－２８９９７５号公報に記載されている。また、前記方法における電荷保持層を熱可塑性樹脂層とし、静電電荷を熱可塑樹脂層表面に記録した後加熱し、熱可塑性樹脂層表面にフロスト像を形成することにより記録された静電電荷を可視化する方法は、例えば特開平３－１９２２８８号公報に記載されている。

【０００３】

更に、本出願人等は、前記情報記録媒体における情報記録層を高分子ー液晶複合体層として、前記同様に電圧印加時露光し、光センサにより形成される電界により液晶層を配向させて情報記録を行い、情報記録の再生にあたっては透過光あるいは反射光により可視情報として再生する情報記録再生方法を、先に特願平４－１７３０３０号、特願平５－１０１２７７号として出願した。この情報記録再生方法は偏光板を使用しなくとも記録された情報を可視化できる。

このような光センサと液晶相からなる情報記録層を設けた情報記録方法では、電極間に電圧を印加しつつ情報光を入射させると、光が入射した部分の光導電層で発生した光キャリアは、両電極により形成される電界により移動し、電圧の再配分が行われ、情報記録層における液晶相が配向し、情報光のパターンに応じた

記録が行なわれるものであり、情報光による露光を終了した後も電圧を印加し続けると光センサは導電性を持続し情報記録層に情報記録を継続することができる。そして、液晶によって動作電圧及びその範囲が異なるものもあるので、印加電圧及び印加電圧時間を設定するにあたっては、情報記録媒体における電圧配分を適宜設定し、情報記録層に印加される電圧配分を液晶の動作電圧領域に設定することが行われており、この情報記録方法は、面状アナログ記録が可能であり、高解像度の記録となり、また露光パターンは液晶相の配向により可視像化されて保持される。

【０００４】

情報記録方法としては、カメラによる方法、またレーザーによる記録方法がある。カメラによる方法としては、通常のカメラに使用されている写真フィルムの代わりに情報記録媒体が使用され、記録部材とするもので、光学的なシャッタも使用しうるし、また電気的なシャッタも使用しうるものである。また、プリズム及びカラーフィルターにより光情報を、Ｒ、Ｇ、Ｂ光成分に分離し、平行光として取り出しＲ、Ｇ、Ｂの各色用の３個の情報記録媒体で１コマを形成するか、または１個の情報記録媒体の異なる部分にＲ、Ｇ、Ｂの各画像を記録して１コマとすることにより、カラー撮影することも可能である。

【０００５】

例えば、ガラス基板上に形成したＩＴＯ膜上にビスアゾ顔料を含有した光導電層を有する光センサに、２００Ｖの電圧を印加した状態で２０ｌｕｘのグリーン光を露光した場合の電流測定結果を図１に示す。未露光部分Ｌ２に比べて露光部Ｌ１の導電性が増加している。図２は、液晶からなる情報記録媒体をコンデンサと抵抗の並列回路とした時の液晶記録層に印加される電圧を露光部と未露光部についてのシミュレーションの結果を示す。未露光部に比べて露光部の導電性が大きいので、液晶記録層により多くの電圧が印加されるので、露光部の液晶が配向し画像を記録することができる。

このため、図１に示した露光部と未露光部の導電性の差がある程度の大きさにならないと液晶記録媒体に良好な画像を記録することができない。

【０００６】
また、このような方法で電圧を印加する場合、電圧印加時間と印加電圧には最適値があり、例えば電圧印加時間が長すぎる場合、未露光部の液晶記録媒体も配向し画像記録ができなくなる。

印加電圧を低くすることにより、電圧印加時間を長くすることもできるが、印加電圧を低くし過ぎた場合には、未露光部の液晶記録媒体の電圧がしきい値電圧に到達しないため、やはり画像記録をすることができない。

以上のように情報記録の際には、規定の時間内に電圧印加を終了する必要があり、それ以上電圧を印加しても有効に情報記録をすることができない。

【０００７】
電圧印加時間は、光センサあるいは情報記録媒体の特性によって異なるが、ほとんどの場合、２００ｍ秒以内であり、３０～５０ｍ秒程度の電圧印加時間で記録する場合が多く、電圧印加時間は未露光部の電流値により決まり、露光強度や露光時間にはほとんど依存しない。

広範な光強度範囲での記録が可能な銀塩写真では、露光強度の小さい画像を記録する場合に、露光時間を長くすることにより良好な画像を記録することができる。また、弱い光によって長時間露光する場合と強い光で短時間露光する場合のいずれの場合も極端な条件でない限りは同様な画像が記録できる相反則が成立する。

【０００８】
図３は、２００Ｖの電圧を印加した状態で６１ｕｘの光を２００ｍ秒間露光したときの電流値を測定した結果であり、図４および図５は、それぞれ６１ｕｘ、２０１ｕｘで露光したときの露光部分と未露光部分の電流値の差を示している。

６１ｕｘの強度で露光した場合、図４に示すように、長時間露光を続けることにより２０１ｕｘで露光した場合と同程度の未露光部と露光部の差の光誘起電流を得ることができる。

しかし、このような光センサを用いて情報記録を行う場合、従来と同様に露光と同時に電圧印加を開始する方法では、電圧印加時間は３０～５０ｍ秒程度（未露光部がしきい値電圧に達するまでの時間）であるため、６１ｕｘの光で露光し

には、この時間内では２０１ｕｘの強度で露光した場合に比べて小さい電圧しか得られないため、良好な画像を記録することができない。

このように、従来の方法で情報記録を行う場合、未露光部の電圧がしきい値電圧に達するまで電圧印加しても、露光強度が低い場合には情報記録を行うことができない。

【０００９】

また、電圧印加条件により記録される画像のラチチュードが狭いと、被写体を十分に表現することができず、ハイライトがとんでしまったり、シャドウ部分がつぶれてしまう等の問題がある。

【００１０】

また、最も一般的な画像記録方法である銀塩写真方式では、広い範囲で相反則が成り立ち、例えば、絞りを開け（露光強度を強くする）、シャッタースピードを速くすることにより、被写体の特定部分にのみ焦点を合わせて、その前後をぼかして記録してみたり、逆に絞りを絞ってシャッタースピードを遅くして、被写体の前後の広い範囲に焦点を合わせて撮影する場合など、シャッタースピードと絞りを制御して露光量を同じにすることで相反則が成り立ち、容易に撮影することができる。また、晴天時の屋外撮影に使用する場合と夜景を撮影するような場合で、露光強度に応じてシャッタースピードを変化させることにより、同じフィルムを使用して撮影することができる。

【００１１】

しかし、光センサと液晶媒体を用いた本発明のシステムで画像記録を行う場合、電圧印加時間が終了した後に画像露光を続けても液晶媒体に記録することができないため、長時間露光ができず、撮影に必要な相反則が成り立たない。このように長時間露光では相反則が成り立たず、また、露光時間が極端に短い領域でも相反則が成り立たないため、様々な条件下で様々な被写体を撮影する場合、このような相反則不軌が問題となる。

【００１２】

【発明が解決しようとする課題】

本発明は、かかる点に鑑みてなされたもので、露光強度の低い場合に長時間露

することにより情報記録媒体への情報記録が可能であり、また、広いラチチュードでの画像記録が可能であり、さらに相反則不軌の領域における撮影時に、補正機能を持たせることにより、様々な条件下で、様々な画像情報を記録できる光センサおよび情報記録方法及び装置を提供することを課題とするものである。

【００１３】

【課題を解決するための手段】

本発明の光センサは、電極上に光導電層を有し、情報記録媒体への情報形成に使用される光センサにおいて、光センサに電圧を印加しない状態、または逆極性の電圧を印加した状態で、露光した後に電圧印加したときに、露光量に応じて光誘起電流が発生し、情報記録が可能であることを特徴とする。

また、本発明の光センサは、電極上に光導電層を有し、情報記録媒体への情報形成に使用される光センサにおいて、電圧を印加した状態で情報露光することによって露光部の導電性が未露光部の導電性よりも増加し、情報露光終了後も露光した部分の導電性が、未露光部分の導電性よりも高く、さらに情報露光した状態、または情報露光終了後に、電圧印加を停止、または逆極性の電圧を印加した後、再びもとの電圧を印加することにより、電圧を印加し続けた場合と導電性が等しくなることを特徴とする。

また、本発明の光センサは、光センサへの10^{5}～10^{6}V／cm^{2}の電界の印加時に、未露光部での通過電流密度が10^{-4}～10^{-7}A／cm^{2}であることを特徴とする。

【００１４】

また、本発明の画像記録方法は、情報露光によって情報記録媒体へ光情報を記録する情報記録方法において、光センサと電極上に情報記録層を形成した情報記録媒体を使用し、光センサもしくは情報記録媒体の少なくともいずれか一方の電極を透明電極とするとともに、光センサと情報記録媒体を間隙を設けて光軸上に対向配置するか、または、光センサと情報記録媒体を直接または誘電体中間層を介して積層し、光情報の露光を行った後に、または光情報の露光中に両電極間に電圧印加を開始することを特徴とする。

また、本発明の情報記録方法は、前記情報記録媒体が、電極上に液晶と樹脂か

らなる高分子ー液晶複合体層を形成した液晶記録媒体であることを特徴とする。

また、本発明の情報記録方法は、光情報の露光終了から一定時間経過後に電圧印加を開始することにより、記録する画像のラチチュードを広げることを特徴とする。

また、本発明の情報記録方法は、光情報の露光終了から電圧印加開始までの時間が０～５００ｍｓｅｃであることを特徴とする。

また、本発明の情報記録方法は、情報露光によって情報記録媒体へ光情報を記録する情報記録再生方法において、光センサと電極上に情報記録層を形成した情報記録媒体を使用し、光センサもしくは情報記録媒体の少なくともいずれか一方の電極を透明電極とするとともに、光センサと情報記録媒体を間隙を設けて光軸上に対向配置するか、または、光センサと情報記録媒体を直接または誘電体中間層を介して積層し、光情報の露光を行うとともに、光情報の露光を行っている間、または光情報の露光終了後に、電圧を印加しない期間もしくは逆極性の電圧を印加する期間を設けることを特徴とする。

【００１５】

また、本発明の情報記録方法は、情報露光によって情報記録媒体へ光情報を記録する情報記録方法において、光センサと、電極上に情報記録層を形成した情報記録媒体を使用し、光センサもしくは情報記録媒体の少なくともいずれか一方の電極を透明電極とするとともに、光センサと情報記録媒体を間隙を設けて光軸上に対向配置するか、または、光センサと情報記録媒体を直接または誘電体中間層を介して積層し、光センサに情報露光し、光センサと情報記録媒体の両電極間に電圧印加して情報記録する方法において、シャッター速度に応じて、適切な画像露光と電圧印加方法を測定し、広い範囲で相反則が成り立つようにしたことを特徴とする。

また、本発明の情報記録方法は、予め測定しておいたシャッター速度と記録特性の関係を基に、絞り又は露光時間を補正することで広い範囲で相反則が成り立つようにしたことを特徴とする。

また、本発明の情報記録方法は、電圧印加開始前に画像露光を開始することにより、相反則不軌を補正することを特徴とする。

また、本発明の情報記録方法は、画像露光中または画像露光終了後に、電圧印加しない期間もしくは逆極性の電圧を印加する期間を設けることにより、相反則不軌を補正することを特徴とする。

【００１６】

また、本発明の情報記録方法は、画像露光終了後、一定時間経過後に電圧印加を開始することにより、相反則不軌を補正することを特徴とする。

【００１７】

また、本発明の情報記録方法は、印加電圧および／または電圧印加時間を制御することにより相反則不軌を補正することを特徴とする。

また、本発明の情報記録装置は、情報露光によって情報記録媒体へ光情報を記録する情報記録装置において、光センサと電極上に情報記録層を形成した情報記録媒体を使用し、光センサもしくは情報記録媒体の少なくともいずれか一方の電極を透明電極とするとともに、光センサと情報記録媒体を間隙を設けて光軸上に対向配置するか、または、光センサと情報記録媒体を直接または誘電体中間層を介して積層し、光情報の露光を行った後に、または光情報の露光中に両電極間に電圧印加を開始する機構を設けたことを特徴とする。

また、本発明の情報記録装置は、透明電極上に光導電層を積層した光センサと、電極上に情報記録層を積層した情報記録媒体を空隙を介して光軸上に対向配置するか、または、光センサの光導電層上に直接または誘電体中間層を介して情報記録層を積層し、さらに上部電極を形成した一体型媒体において、光センサに画像露光し、両電極間に電圧印加することにより、露光量に応じて画像情報等を記録する装置において、露光強度を測光し、露光時間を算出する手段を有し、および／または露光時間を入力する手段を有し、露光時間の広い範囲で相反則が成り立つように、露光時間に応じて適切な条件でシャッターと電源を制御する機能を有することを特徴とする。

【００１８】

本発明の光センサは、電極上に光導電層を積層してなり、その光導電層は単層型のものと電荷発生層及び電荷輸送層を積層した積層型のものがある。光導電層は、一般には光が照射されると照射部分で光キャリア（電子、正孔）が発生し、

キャリアが層幅を移動することができる機能を有するものであるが、本の光センサは後述する光導電層と電極とを適宜組み合わせ、半導電性を持たせることにより、光センサへの光照射時において情報記録媒体に付与される電界または電荷量が光照射につれて経時的に増幅され、また光照射を終了した後でも電圧を印加し続けるとその増加した導電性を持続し、引続き電界または電荷量を情報記録媒体に付与し続ける作用を有するに到るものである。

本発明の光センサは、持続導電性および増幅作用を有しているが、従来から知られている持続導電性を有するといわれている光感光体は、本来は絶縁性のものであり、これに光照射等によって導電性を与える過程において、持続導電性が生じるものである。これに対して、本発明の光センサは、もともと半導電性の特性を有しており、このことが本発明の作用を得るための要件であり、絶縁性のものでは本発明の作用を得ることはできない。

【００１９】

図６は、光センサを説明するための断面図である。

光センサ１０は、基板１１上に形成した電極１２上に、光導電層１３が設けられており、光導電層１３は電荷発生層１４および電荷輸送層１５から構成されている。光導電層は光が照射されると照射部分で電子、正孔等の光キャリアが発生し、それらのキャリアが層幅を移動することができる導電性層であり、とくに電界が存在する場合に、その効果が顕著である層である。

電荷発生層１４は、バインダー樹脂と電荷発生性物質からなり、電荷発生性物質としては、特願平５－４７２１号に記載されているようなピリリウム系染料、チアピリリウム系染料、アズレニウム系染料、シアニン系染料、アズレニウム系染料等のカチオン系染料、スクバリリウム塩系染料、フタロシアニン系顔料、ペリレン系顔料、ピラントロン系顔料等の多環キノン系顔料、インジゴ系顔料、キナクリドン系顔料、ピロール系顔料、アゾ系顔料等の染料、顔料を単層中で複数のものを組み合わせて使用することができる。また、電荷発生層を２層設け、それぞれの層に単一の電荷発生性物質を使用してもよい。

また、電荷発生層には、電子受容性物質を添加してもよい。電子受容性物質としては、２，４，７－トリニトロフルオレノン、テトラフルオロ－Ｐ－ベンゾキ

テトラシアノキノジメタン、トリフェニルメタン、無水マレイン酸、ヘキサシアノブタジエン等を使用することができる。

【0020】

バインダー樹脂としては、例えばポリ塩化ビニル樹脂、ポリ酢酸ビニル樹脂、アクリル樹脂、ポリエステル樹脂、ポリビニルホルマール樹脂、ポリビニルブチラール樹脂、ポリスチレン樹脂、ポリカーボネート樹脂、ポリブチルメタクリレート樹脂、ポリ塩化ビニリデン樹脂、エチルセルロース樹脂、シリコーン樹脂、エポキシ樹脂、フェノール樹脂、メラミン樹脂、紫外線硬化性樹脂、熱硬化性樹脂、塩化ビニル−酢酸ビニル共重合体樹脂、塩化ビニル−アクリル共重合体樹脂、塩化ビニル−エチレン共重合体樹脂、アクリル−スチレン共重合体樹脂、スチレン−ブタジエン共重合体樹脂、エチレン−酢酸ビニル共重合体樹脂等が挙げられる。

使用するバインダー樹脂は、分子量が大きくなると塗布特性が好ましくないので、平均分子量が1，０００〜１００，０００のものを使用することが好ましい。

これらの電荷発生性物質とバインダー樹脂との混合比は、電荷発生性物質１重量部に対してバインダーを０〜１０重量部、好ましくは０．３〜１重量部の割合で使用するとことが望ましい。電子受容性物質は、電荷発生性物質１モルに対して０，０００１〜１０モルの割合で使用することができる。電荷発生層は乾燥後膜厚として０．０１〜１μmであり、好ましくは０．１〜０．３μmとするとよい。

【0021】

電荷輸送層１５は電荷輸送性物質とバインダーとから構成されている。電荷輸送性物質は、電荷発生性物質で発生した電荷の輸送特性が良い物質であり、例えばオキサジアゾール系、オキサゾール系、トリアゾール系、チアゾール系、トリフェニルメタン系、スチリル系、ピラゾリン系、ヒドラゾン系、芳香族アミン系、カルバゾール系、ポリビニルカルバゾール系、スチルベン系、エナミン系、アジン系、アミン系、ブタジエン系、多環芳香族化合物系等があり、ホール輸送性の良い物質とすることが必要である。

【0022】

好ましくは、ブタジエン系、スチルベン系電荷輸送性物質が挙げられ、具体的には特開昭62−287257号公報、特開昭58−182640号公報、特開昭48−43942号公報、特公昭34−5466号公報、特開昭58−198043号公報、特開昭57−101844号公報、特開昭59−195660号公報、特開昭60−69657号公報、特開昭64−65555号公報、特開平1−164952号公報、特開昭64−57263号公報、特開昭64−68761号公報、特開平1−230055号公報、特開平1−142654号公報、特開平1−142655号公報、特開平1−155358号公報、特開平1−155357号公報、特開平1−161245号公報、特開平1−142643号公報等に記載した電荷輸送材料が挙げられる。

これらの電荷発生性物質と電荷輸送性物質の組合せとしては、例えばフルオレノンアゾ顔料（電荷発生性物質）とスチルベン系、トリフェニルアミン系の電荷輸送性物質の組合せ、ビスアゾ系顔料（電荷発生性物質）とブタジエン系、ヒドラゾン系の電荷輸送性物質の組合せ等が良好である。

また、以上のように電荷として正孔を輸送することに代えて電子を輸送する場合には、電子輸送物質としては、特願平5−4721号に記載の電子輸送物質を用いることができる。　バインダー樹脂としては、上記した電荷発生層におけるバインダー樹脂と同様のものが使用できるが、好ましくはポリ塩化ビニル樹脂、ポリ酢酸ビニル樹脂、アクリル樹脂、ポリエステル樹脂、ポリビニルホルマール樹脂、ポリビニルブチラール樹脂、ポリスチレン樹脂、ポリカーボネート樹脂、ポリブチルメタクリレート樹脂、ポリ塩化ビニリデン樹脂、エチルセルロース樹脂、シリコーン樹脂、エポキシ樹脂、フェノール樹脂、メラミン樹脂、塩化ビニル−酢酸ビニル共重合体樹脂、塩化ビニル−アクリル共重合体樹脂、塩化ビニル−エチレン共重合体樹脂、アクリル−スチレン共重合体樹脂、スチレン−ブタジエン共重合体樹脂、エチレン−酢酸ビニル共重合体樹脂等ポリビニルアセタール樹脂、スチレン樹脂、スチレン−ブタジエン共重合体樹脂が挙げられるが、電荷輸送性物質がバインダー樹脂としての作用を有する場合にはバインダー樹脂の使用は必要がない。使用するバインダー樹脂は、分子量が大きくなると塗布特性が

劣化するので、平均分子量が１，０００～１００，０００のものを使用することが好ましい。

バインダー樹脂は、電荷輸送性物質１重量部に対して０．０５～１重量部の割合で使用することが望ましい。電荷輸送層は乾燥後膜厚として１～５０μmであり、好ましくは５～３０μmとするとよい。

また、電荷輸送層には、電荷発生層の項で記載した電子受容性物質を同様に電荷輸送性物質１モルに対して電子受容物質を０．０００１～１０モルの割合で、配合することができる。電荷輸送層は、電荷輸送性物質、バインダー樹脂、電子受容物質を電荷発生層の項で記載したと同様の溶剤に溶解、または分散させ、同様の塗布法により電荷発生層上への塗布、乾燥工程を経て、乾燥後膜厚１～５０μmに形成される。

【００２３】

とくに、本発明の光センサにおいては、電荷発生性物質と電荷輸送性物質の相互作用によって光センサにおいて感度を高くしている。電荷発生効率を高めるためには、電荷輸送層におけるバインダー樹脂の割合を少なくすることが有効であるが、バインダー樹脂の量が少なくなると、電荷輸送層として平滑な層を形成することが困難となり、また光キャリアの発生効率が電荷発生層と電荷輸送層の界面の状態で変化するので、界面が平滑でないと高性能な光センサを得ることができない。

【００２４】

本発明は、電荷発生層中に電荷輸送層に含まれる電荷輸送性物質を混合することにより、光センサが高感度化することを見いだしたものである。電荷発生層中に混合する電荷輸送性物質の量は、電荷発生性物質に対してモル比で０．０１～１０であることが好ましく、０．１～１であることがとくに好ましく、０．０１以下であると添加の効果が得られず、１０以上である場合には、暗電流が小さく、本発明の情報記録方法に適さないので好ましくない。

また、電荷発生層中に混合する電荷輸送性物質は、電荷発生層に積層する電荷輸送層に使用する電荷輸送性物質と同一の電荷輸送性物質を使用しても良いし、あるいはこれらとは異なる電荷輸送性物質を用いても良い。

【0025】

電極１２は、後述する情報記録媒体が不透明であれば透明性を有することが必要であるが、情報記録媒体が透明性を有する場合には透明、不透明いずれでもよく、５０～１０４Ω／cm^2 の表面抵抗率を安定して与える材料、例えば亜鉛、チタン、銅、鉄、錫等の金属薄膜導電膜、酸化錫、酸化インジウム、酸化亜鉛、酸化チタン、酸化タングステン、酸化バナジウム等の無機金属酸化物導電膜、四級アンモニウム塩等の有機導電膜等であり、単独か或いは二種以上の複合材料として用いられる。なかでも酸化物半導体が好ましく、特に酸化インジウム酸化錫複合酸化物（ＩＴＯ）が好ましい。

【0026】

電極１２は蒸着、スパッタリング、ＣＶＤ、コーティング、メッキ、ディッピング、電解重合等の方法により形成される。またその膜厚は電極を構成する材料の電気特性、および情報記録の際の印加電圧により変化させる必要があるが、例えばＩＴＯ膜では１０～３００ｎｍ程度であり、情報記録層との間の全面、或いは光導電層の形成パターンに合わせて形成される。

基板１１は、後述する情報記録媒体が不透明であれば透明性を有することが必要であるが、情報記録媒体が透明性を有する場合には透明、不透明いずれでもよく、カード、フィルム、テープ、ディスク等の形状を有し、光センサを強度的に支持するものである。光センサ自体が支持性を有する場合には設ける必要がないが、光センサを支持することができるある程度の強度を有していれば、その材質、厚みは特に制限がない。例えば可撓性のあるプラスチックフィルム、或いはガラス、ポリエステル、ポリカーボネート等のプラスチックシート、カード等の剛体が使用される。

なお、基板の電極１２が設けられる面の他方の面には、電極１２が透明であれば必要に応じて反射防止効果を有する層を積層するか、また反射防止効果を発現しうる膜厚に透明基板を調整するか、更に両者を組み合わせることにより反射防止性を付与するとよい。

【0027】

次に、本発明の情報記録方法について説明する。図７は、本発明の方法に使用

情報記録装置を説明する断面図である。光センサ１０と情報記録媒体２０がスペーサ１６を介して対向配置し積層して構成される。

情報記録媒体２０について説明する。まず、本発明における情報記録媒体としては、その情報記録層が高分子一液晶複合体とする場合が挙げられる。

高分子一液晶複合体は樹脂相と液晶相からなり、液晶相中に樹脂粒子が分散した構造を有しているが、液晶材料は、スメクチック液晶、ネマチック液晶、コレステリック液晶あるいはこれらの混合物を使用することができる。液晶としてはその配向性を保持し、情報を永続的に保持させるのでメモリー性の観点から、スメクチック液晶を使用するのが好ましい。

スメクチック液晶としては、液晶性を呈する物質の末端基の炭素鎖が長いシアノビフェニル系、シアノターフェニル系、フェニルエステル系、更に弗素系等のスメクチックＡ相を呈する液晶物質、強誘電性液晶として用いられるスメクチックＣ相を呈する液晶物質、或いはスメクチックＨ、Ｇ、Ｅ、Ｆ等を呈する液晶物質等が挙げられる。

【００２８】

又、ネマチック液晶を使用してもよく、スメクチック或いはコレステリック液晶と混合することによりメモリー性を向上させることができ、例えば、シッフ塩基系、アゾキシ系、アゾ系、安息香酸フェニルエステル系、シクロヘキシル酸フェニルエステル系、ビフェニル系、ターフェニル系、フェニルシクロヘキサン系、フェニルピリジン系、フェニルオキサジン系、多環エタン系、フェニルシクロヘキセン系、シクロヘキシルピリミジン系、フェニル系、トラン系等の公知のネマチック液晶を使用できる。又、ポリビニルアルコール等と液晶材料を混合してマイクロカプセル化したものも使用できる。なお、液晶材料を選ぶ際には、屈折率の異方向性の大きい材料の方がコントラストがとれるので好ましい。

【００２９】

樹脂粒子を形成する材料としては、例えば、紫外線硬化型樹脂であって、モノマー、オリゴマーの状態で液晶材料と相溶性を有するもの、或いはモノマー、オリゴマーの状態で液晶材料と共通の溶媒に相溶性を有するものを好ましく使用できる。このような紫外線硬化型樹脂としては、例えばアクリル酸エステル、メタ

クリル酸エステル等が挙げられ、モノマー、オリゴマーの状態で、例えばジペンタエリスリトールヘキサアクリレート、トリメチロールプロパントリアクリレート、ポリエチレングリコールジアクリレート、ポリプロピレングリコールジアクリレート、イソシアヌール酸（エチレンオキサイド変性）トリアクリレート、ジペンタエリスリトールペンタアクリレート、ジペンタエリスリトールテトラアクリレート、ネオペンチルグリコールジアクリレート、ヘキサンジオールジアクリレート等の多官能性モノマー或いは多官能性ウレタン系、エステル系オリゴマー、更にノニルフェノール変性アクリレート、Ｎ－ビニル－２－ピロリドン、２－ヒドロキシ－３－フェノキシプロピルアクリレート等の単官能性モノマー或いはオリゴマー等が挙げられる。

溶媒としては、使用材料に共通の溶媒であれば特に問題はなく、例えばキシレン等に代表される炭化水素系溶媒、クロロホルム等に代表されるハロゲン化炭化水素系溶媒、メチルセロソルブ等に代表されるアルコール誘導体系溶媒、ジオキサン等に代表されるエーテル系溶媒等が挙げられる。

【００３０】

紫外線硬化型樹脂を硬化させる光硬化剤としては、例えば２－ヒドロキシ－２－メチル－１－フェニルプロパン－１－オン（メルク社製　ダロキュア１１７３）、１－ヒドロキシシクロヘキシルフェニルケトン（チバ・ガイギー社製　イルガキュア１８４）、１－（４－イソプロピルフェニル）－２－ヒドロキシ－２－メチルプロパン－１－オン（メルク社製　ダロキュア１１１６）、ベンジルジメチルケタール（チバ・ガイギー社製　イルガキュア６５１）、２－メチル－１－〔４－（メチルチオ）フェニル〕－２－モルホリノプロパノン－１（チバ・ガイギー社製　イルガキュア９０７）、２，４－ジエチルチオキサントン（日本化薬社製　カヤキュアＤＥＴＸ）とｐ－ジメチルアミノ安息香酸エチル（日本化薬社製カヤキュアＥＰＡ）との混合物、イソプロピルチオキサントン（ワードブレキンソップ社製　クンタキュア・ＩＴＸ）とｐ－ジメチルアミノ安息香酸エチルとの混合物等が挙げられるが、液状である２－ヒドロキシ－２－メチル－１－フェニルプロパン－１－オンが液晶材料、重合体形成性モノマー若しくはオリゴマーとの相溶性の面で特に好ましい。

液晶材料と樹脂の使用割合は、液晶の含有量が１０～９０重量％、好ましくは４０～８０重量％となるように使用するとよく、１０重量％未満であると情報記録により液晶相が配向しても光透過性が低く、また、９０重量％を越えると液晶の滲み出し等の現象が生じ、画像ムラが生じ好ましくない。液晶は情報記録相中に多く存在させることにより、コントラスト比を向上させ、動作電圧を低くすることができる。

【００３１】

情報記録層の形成方法は、樹脂形成用材料と液晶、光硬化剤等を溶媒に溶解または分散させた混合溶液を、電極上にブレードコーター、ロールコーター、或いはスピンコーター等の塗布方法により塗布し、光または熱により樹脂形成用材料を硬化させることにより形成される。なお、必要に応じて、溶液の塗布適性を向上させ、表面性を良くするためにレベリング剤を添加してもよい。

情報記録層形成にあたっては、樹脂形成用材料と液晶との混合液が等方相を保持する温度以上に混合溶液を加熱し、液晶と紫外線硬化型樹脂形成材料とを完全に相溶させることが必要であり、これにより、樹脂相と液晶相とが均一に分散した情報記録層とすることができる。液晶が等方相を示す温度以下で紫外線硬化させると、液晶と紫外線硬化型樹脂材料との相分離が大きくなるという問題が生じる。すなわち、液晶ドメインが成長しすぎ、情報記録層表面にスキン層が完全に形成されず、液晶の滲み出し現象が生じたり、また紫外線硬化型樹脂がマット化し、正確に情報を取り込むことが困難となり、好ましくなく、紫外線硬化型樹脂が液晶を保持できず、情報記録層を形成されないことすらある。他方、溶媒を蒸発させる際に、等方相を保持するために加熱が必要な場合には、特に電極に対する濡れ性が低下し、均一な情報記録層が得られないという問題がある。

【００３２】

電極に対する濡れ性を維持するとともに樹脂の表面に被膜を形成することを目的として、情報記録層に弗素系界面活性剤を添加するとよい。このような弗素系界面活性剤としては、例えば住友スリーエム（株）製、フロラードＦＣ－４３０、同フロラードＦＣ－４３１、Ｎ－（ｎ－プロピル）－Ｎ－（β－アクリロキシエチル）－パーフルオロオクチルスルホン酸アミド（三菱マテリアル（株）製Ｅ

F－１２５M）、N－（n－プロピル）－N－（β－メタクリロキシエチル）－パーフルオロオクチルスルホン酸アミド（三菱マテリアル（株）製ＥＦ－１３５M）、パーフルオロオクタンスルホン酸（三菱マテリアル（株）製ＥＦ－１０１）、パーフルオロカプリル酸（三菱マテリアル（株）製ＥＦ－２０１）、N－（n－プロピル）－N－パーフルオロオクタンスルホン酸アミドエタノール（三菱マテリアル（株）製ＥＦ－１２１）、更に三菱マテリアル（株）製ＥＦ－１０２、同ＥＦ－１０３、同ＥＦ－１０４、同ＥＦ－１０５、同ＥＦ－１１２、同ＥＦ－１２１、同ＥＦ－１２２Ａ、同ＥＦ－１２２Ｂ、同ＥＦ－１２２Ｃ、同ＥＦ－１２２Ａ３、同ＥＦ－１２３Ａ、同ＥＦ－１２３Ｂ、同ＥＦ－１３２、同ＥＦ－３０１、同ＥＦ－３０３、同ＥＦ－３０５、同ＥＦ－３０６Ａ、同ＥＦ－５０１、同ＥＦ－７００、同ＥＦ－２０１、同ＥＦ－２０４、同ＥＦ－３５１、同ＥＦ－３５２、同ＥＦ－８０１、同ＥＦ－８０２、同ＥＦ－１２５ＤＳ、同ＥＦ－１２００、同ＥＦ－Ｌ１０２、同ＥＦ－Ｌ１５５、同ＥＦ－Ｌ１７４、同ＥＦ－Ｌ２１５等が挙げられる。また、３－（２－パーフルオロヘキシル）エトキシ－１，２－ジヒドロキシプロパン（三菱マテリアル（株）製ＭＦ－１００）、N－n－プロピル－N－２，３－ジヒドロキシプロピルパーフルオロオクチルスルホンアミド（三菱マテリアル（株）製ＭＦ－１１０）、３－（２－パーフルオロヘキシル）エトキシ－１，２－エポキシプロパン（三菱マテリアル（株）製ＭＦ－１２０）、N－n－プロピル－N－２，３－エポキシプロピルパーフルオロオクチルスルホンアミド（三菱マテリアル（株）製ＭＦ－１３０）、パーフルオロヘキシルエチレン（三菱マテリアル（株）製ＭＦ－１４０）、N－（３－トリメトキシシリル）プロピル）パーフルオロヘプチルカルボン酸アミド（三菱マテリアル（株）製ＭＦ－１５０）、N－（３－トリメトキシシリル）プロピル）パーフルオロヘプチルスルホンアミド（三菱マテリアル（株）製ＭＦ－１６０）等が挙げられる。弗素系界面活性剤は、液晶と樹脂形成材料との合計量に対して０．１～２０重量％の割合で添加される。

【００３３】

また、情報記録層形成における塗布溶液における固形分濃度は１０～６０重量％とするとよく、硬化に際して、樹脂の種類、濃度、塗布層温度、また紫外線照

射条件等の硬化条件を適宜に設定することにより、外表皮層として液晶相を有しない樹脂層のみからなるスキン層を良好に形成させることができ、これにより情報記録層における液晶の使用割合を増大することができ、また液晶の滲み出しを無くすることができる。

以上、樹脂材料として紫外線硬化型樹脂について説明したが、その他、液晶材料と共通の溶媒に相溶性を有する溶媒可溶型の熱硬化性樹脂、例えばアクリル樹脂、メタクリル樹脂、ポリエステル樹脂、ポリスチレン樹脂、及びこれらを主体とした共重合体等、エポキシ樹脂、シリコーン樹脂等を使用してもよい。

情報記録層の膜厚は解像性に影響を与えるので、乾燥後膜厚０．１～１０μｍ、好ましくは３～８μｍとするとよく、高解像性を維持しつつ、動作電圧も低くすることができる。膜厚が薄すぎると情報記録部のコントラストが低く、また、厚すぎると動作電圧が高くなるので好ましくない。

【００３４】

なお、情報記録層がそれ自体支持性を有し、支持体を省略する場合には、情報記録層の表面にはスキン層が形成されているので、例えばＩＴＯ膜を蒸着法、スパッタ法等により積層してもひび割れが生じなく、導電性の低下のないものとできる。この場合、仮支持体上に設けた情報記録層上に電極を設けた後、仮支持体を剥離して情報記録媒体とするとよい。

【００３５】

情報記録媒体の基板２１上に電極２２が積層され、電極上には情報記録層２３が形成されている。電極２２は、上述の光センサにおける電極１２と同様の材料、及び同様の積層方法で基板２１上に設けられる。

この情報記録媒体は、図７に示すように上述した光センサとスペーサー１６を介して、対向配置し、両電極１２、２２を電圧源Ｖを介して結線して第１の情報記録装置とされる。この装置における電極１２、２２は、いずれか一方、または両方が透明であればよい。

スペーサーとしては、ポリエチレンテレフタレート等のポリエステル、ポリイミド、ポリエチレン、ポリ塩化ビニル、ポリ塩化ビニリデン、ポリアクリロニトリル、ポリアミド、ポリプロピレン、酢酸セルロース、エチルセルロース、ポリ

カーボネート、ポリスチレン、ポリテトラフルオロエチレン等の樹脂フィルムを使用して形成するとよく、また、上記各樹脂溶液を塗布、乾燥させて形成してもよい。また、アルミニウム、セレン、テルル、金、白金等の金属材料又は無機或いは有機化合物を蒸着して形成してもよい。スペーサーの膜厚は、光センサと情報記録媒体との空隙距離となり、情報記録層に印加される電圧配分に影響を与えるので、少なくとも１００μm以下とするとよく、好ましくは３～３０μmとするとよい。

【００３６】

また、本発明の情報記録装置は、光センサと情報記録媒体を間隙を設けて配置する以外に、光センサと情報記録媒体とを直接積層するか、あるいは光センサの光導電層上に絶縁性の誘電体層を形成した後に、情報記録層および上部電極を形成した一体型にしても良い。

誘電体層を形成する材料としては、無機材料では SiO_2 、TiO_2、CeO_2、Al_2O_3 、GeO_2、Si_3N_4 、AlN 、TiN 等を使用し、蒸着法、スパッタ法、化学蒸着（ＣＶＤ）法等により積層して形成するとよい。また、有機溶剤に対して相溶性の少ない水溶性樹脂、例えばポリビニルアルコール、水系ポリウレタン、水ガラス等の水溶液を使用し、スピンコート法、ブレードコート法、ロールコート法等により積層してもよい。更に、塗布可能なフッ素樹脂を使用してもよく、この場合にはフッ素系溶剤に溶解し、スピンコート法により塗布するか、またブレードコート法、ロールコート法等により積層してもよい。

塗布可能なフッ素樹脂としては、例えば特開平１－１３１２１５号公報等に開示されたフッ素樹脂、更に真空系で膜形成されるポリパラキシリレン等の有機材料を好ましく使用することができる。

【００３７】

次に、本発明の情報記録装置への情報記録方法について、光センサと情報記録媒体を間隙を設けて配置する例について説明する。図８は、本発明の光センサを使用した情報記録方法を説明する図である。

情報光によって露光の後に、電極１２、２２間に電圧を印加、情報光１７による露光とともに印加電圧を断続的に供給、あるいは電圧の印加を停止した後に再

度電圧を印加する等の電圧の印加を制御する制御装置１８を有しており、光が入射した部分の電荷発生層１４、電荷輸送層１５からなる光導電層で発生した光キャリアは、両電極により形成される電界により移動し、電圧の再配分が行われ、情報記録層における液晶相が配向し、情報光１７のパターンに応じた記録が行なわれる。なお、情報光１７を入射しつつ、電圧を所定時間印加してもよい。

【００３８】

また、液晶によって動作電圧及び範囲が異なるものもあるので、印加電圧及び印加電圧時間を設定するにあたっては、情報記録媒体における電圧配分を適宜設定し、情報記録層にかかる電圧配分を液晶の動作電圧領域に設定するとよい。この情報記録方法は、面状アナログ記録が可能であり、液晶レベルでの記録が得られるので、高解像度の記録となり、また露光パターンは液晶相の配向により可視像化されて保持される。

【００３９】

情報記録方法としては、カメラによる方法、またレーザーによる記録方法がある。カメラによる方法としては、通常のカメラに使用されている写真フィルムの代わりに情報記録媒体が使用され、記録部材とするもので、光学的なシャッタも使用しうるし、また電気的なシャッタも使用しうるものである。また、プリズム及びカラーフィルターにより光情報を、Ｒ、Ｇ、Ｂ光成分に分離し、平行光として取り出しＲ、Ｇ、Ｂの各色用の３個の情報記録媒体で１コマを形成するか、または１個の情報記録媒体の異なる部分にＲ、Ｇ、Ｂの各画像を記録して１コマとすることにより、カラー撮影することもできる。

【００４０】

また、レーザーによる記録方法としては、光源としてはアルゴンレーザー（５１４．４８８ｎｍ）、ヘリウムーネオンレーザー（６３３ｎｍ）、半導体レーザー（７８０ｎｍ、８１０ｎｍ等）が使用でき、画像信号、文字信号、コード信号、線画信号に対応したレーザー露光をスキャニングにより行うものである。画像のようなアナログ的な記録は、レーザーの光強度を変調して行い、文字、コード、線画のようなデジタル的な記録は、レーザー光のＯＮ－ＯＦＦ制御により行う。また画像において網点形成されるものには、レーザー光にドットジェネレータ

ーにＯＮ－ＯＦＦ制御を行って形成するものである。

【００４１】

情報記録媒体に記録された露光情報は、情報記録媒体を分離し、透過光により情報を再生すると、情報記録部では液晶が電界方向に配向するために光は透過するのに対して、情報を記録していない部位においては光は散乱し、情報記録部とのコントラストがとれる。また、これらの情報記録装置で記録された情報は、反射光により読み取ってもよい。

液晶の配向により記録された情報は、目視による読み取りが可能な可視情報であるが、投影機により拡大して読み取ることもでき、レーザースキャニング、或いはＣＣＤを用いて透過光、または反射光により高精度で情報を読み取ることができ、必要に応じてシュリーレン光学系を用いることにより散乱光を防ぐことができる。

【００４２】

本発明の情報記録装置における情報記録媒体は、静電情報を液晶の配向により可視化した状態で記録するものであるが、液晶と樹脂との組合せを選ぶことにより、一度配向し可視化した情報は消去せず、メモリ性が付与される。また、等方相転移付近の高温に加熱すると、メモリー性を消去することができるので、再度の情報記録に使用することができる。

【００４３】

本発明の光センサは、上述のように高分子－液晶複合体を情報記録層とする情報記録媒体への情報記録に適しているが、他の情報記録媒体、例えば特開平４－７０８４２号公報、特開平４－４６３４７号公報、特開平３－７９４２号公報、特開平４－７３７６９号公報等に記載された、弗素樹脂等の電荷保持性に優れた絶縁性樹脂層を情報記録層とする静電情報記録媒体であって、情報を静電荷の形で蓄積し、トナー現像されるか、電位読み取りにより静電情報を再生することができる情報記録媒体や、また特開平３－１７０９８５号公報、特開平３－１７０９８４号公報、特開平３－１９２２８８号公報等に記載された、熱可塑性樹脂層を情報記録層とする情報記録媒体であって、上記同様に情報を静電荷の形で表面に蓄積した後、加熱されることにより、情報をフロスト像として蓄積し、可視情

報として情報再生することが可能な情報記録媒体に対する情報記録にも使用できる。

また、本発明の光センサは作製したままの状態では、本発明の特徴である半導電性を有さないため、本発明で使用することはできない。本発明で使用するためには、所定時間以上に放置することにより、暗所においても所定の半導電性を示すセンサーとなる。また、光センサとしての使用前に十分な露光量の光を全面に一様露光した後使用しても良い。

【００４４】

本発明の光センサは、露光強度が低い場合でも、電圧印加と露光の開始時点を変化させることにより、コントラストの充分な情報を記録することができる。また電圧印加と露光の開始時点により液晶記録層に印加される電位差が最大になる時間も異なるため、それぞれに応じて最適な印加電圧と電圧印加時間で情報記録を行うことができる。

また、本発明の光センサは、露光後もしくは露光と同時に電圧印加した後に電圧印加を停止し、再び電圧印加を行うか、逆極性の電圧を印加後に再び電圧を印加することにより露光部と未露光部で導電性に差が生じる。また、電圧印加を停止しているかもしくは逆極性の電圧を印加している間に、露光することにより再び電圧印加した際には、電圧印加をし続けた場合と同様に、露光部分の導電性が高くなっている。

【００４５】

また、電圧印加を複数回行うことによりコントラストの大きな画像情報を記録することができる。１回目の電圧印加露光により、未露光部分の液晶記録媒体の電圧がしきい値になり、配向を開始した直後に電圧印加を停止するか、最初に印加した電圧より低い電圧または逆極性の電圧を印加することにより、液晶記録層の電圧を低くすることができる。この状態でしばらく経過した後に再び電圧印加し、未露光部の電圧がしきい値になるまで、電圧印加を続ける。電圧印加を停止した状態または逆極性の電圧が印加されている状態では、光センサには逆極性の電圧が印加される場合もあるが、再び電圧が印加されることにより、未露光部分と露光部分の導電性に違いが生じるため、液晶記録層の露光部分により多くの電

圧が印加されることになり情報記録をすることができる。

繰り返し電圧印加した場合の液晶記録層および光センサに印加される電圧の変化の一例を図９に示す。ここでは、液晶記録媒体と光センサは空気層を介して対向配置した例を示したが、光センサと液晶記録媒体は直接もしくは誘電体層を介して積層したものであっても同様の電圧印加方法によって情報記録を行うことができる。

【００４６】

また、光センサに２種類以上の画像情報を多重露光して記録する方法について示す。図１０は、２つの画像情報を記録する方法について示す。電圧印加する前に、１つの画像情報をｔ１の期間露光し、もう一つの画像情報をｔ２の期間露光すると同時にｔ３の期間電圧印加し情報記録を行う。このような方法で２種類以上の画像情報、例えば絵と文字とを重ね合わせて１枚の画像として記録することができる。このように画像情報は液晶記録媒体の同じ場所に重ね合わせて記録することもできるし、それぞれの画像情報を別々の場所に記録することもできる。

一度の電圧印加で複数の画像情報を記録することで、２回目以降の画像を記録する際に、それ以前に記録した画像情報を乱すことなしに画像情報の記録を行うことができる。重ね合わせる画像情報の数に制限はないが、最初の画像情報を露光してからあまり長い間経過してから電圧印加をすると、画像情報が消滅していることがあるので、比較的短時間で画像記録を行う必要がある。

また、画像情報は時間とともに減衰するため、各画像情報を等しい強度で記録するためには、露光時間を調整する等の工夫が必要である。

【００４７】

レーザーで記録する場合には、光センサにレーザー光を走査することにより画像や文字の情報を記録することができる。光センサと液晶記録媒体を対向配置した状態でレーザー光を走査することにより、光センサ上に画像や文字情報を描画し、描画終了後、光センサと液晶記録媒体には両電極間に電圧を印加することにより画像記録をすることができる。液晶記録媒体には、レーザー光を用いて熱により書き込むことができるが、熱による書き込みでは熱の拡散により高解像度の描画ができない問題があるが、このように光りセンサーに描画し、電圧印加して

記録することにより高解像度の画像を記録することができる。

【００４８】

【作用】

電極上に光導電層を積層してなる光センサと、電極上に電界または電荷により情報記録可能な情報記録層を積層してなる情報記録媒体とが対向させて配置され、情報光によって露光した後に光センサの電極と情報記録媒体との電極間に電圧を印加するか、情報光を露光した状態で光センサの電極と情報記録媒体との電極間の電圧印加を停止、もしくは逆極性の電圧の印加後に再度電圧の印加を行うようにしたので、未露光部と露光部の導電性の差が大きいので、弱い光による長時間露光によってもコントラストの大きな情報を記録することができる。

【００４９】

また、本発明は電圧印加開始より前に画像露光し、その時間差を変えることにより記録画像のラチチュードを変えることができ、また、本発明の記録方法をカメラに適用した場合、カメラに必要な相反則を成り立たせるように補正することが可能である。

【００５０】

【実施例】

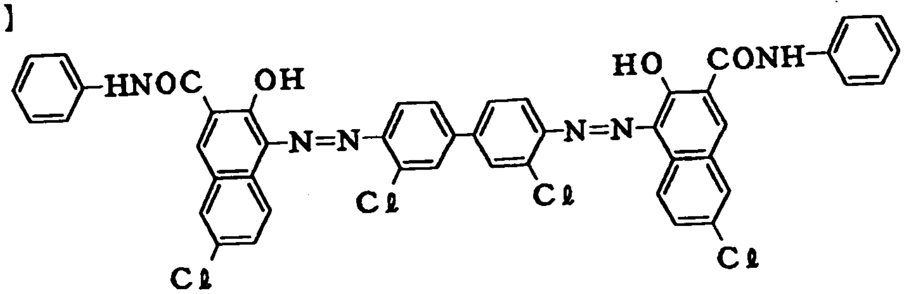
実施例１

充分洗浄した厚さ１．１ｍｍのガラス基板上に、膜厚１００ｎｍのＩＴＯ膜をスパッタリングにより成膜し電極層を得た。

その電極上に、下記構造を有するビスアゾ顔料３重量部、塩化ビニル－酢酸ビニル共重合体０．７５重量部、ポリ酢酸ビニル０．２５重量部、１．４－ジオキサン９８重量部、シクロヘキサノン９８重量部を混合しペイントシェーカーで６時間分散して塗布液とし、スピンナーにて１４００ｒｐｍ、０．４秒で塗布した後、１００℃、１時間乾燥して、膜厚３００ｎｍの電荷発生層を積層した。

【0051】

【化1】

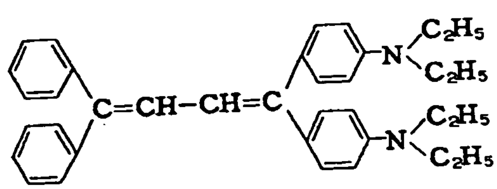


【0052】

この電荷発生層上に、電荷輸送性物質として下記構造の化合物を１重量部、ポリスチレン樹脂を４重量部、１、１、２－トリクロロメタン２２重量部、ジクロロメタン１４重量部を混合した塗布液を、スピンナーにて４００ｒｐｍ、０．４秒間で塗布した後８０℃、２時間乾燥して電荷輸送層を積層し、電荷発生層と電荷輸送層からなる膜厚２０μｍの光導電層を有する光センサを得た。得られた光センサは作製後、相対湿度６０％以下の暗所下に３日間エージングしたのちに使用した。

【0053】

【化2】



【0054】

図１１に、本発明の光センサの特性の測定方法を示す。光センサ１０は基板１１上に透明電極１２を有し、透明電極上には電荷発生層と電荷輸送層からなる光導電層１３を有し、光導電層上には金電極３１を０．１６ｃｍ^2 の大きさで形成している。光源３２からフィルター３３を透過した緑色光はパルス発生装置３４によって開閉を制御されるシャッター３５から光センサ１０を照射する。また、パルス発生装置は金電極３１と透明電極間１２に直流電流を透明電極側が正になるように印加する電源３６の電圧および電圧印加時間を制御する。また、金電極

側に結合した抵抗から電圧を取り出してオシロスコープ３７によって光誘起電流を測定した。

【００５５】

露光強度２０ｌｕｘ、露光時間３３ｍ秒とし、露光開始と同時に２００Ｖの電圧を印加した場合の光センサに流れる電流Ｌ１（明電流）と、露光しない場合の電流Ｌ２（暗電流）を図１２に示し、明電流と暗電流との差で表される光誘起電流を図１３に示す。光誘起電流は露光中は増加し、露光終了後も電圧印加中は緩やかに減衰し、充分長い時間流れ続ける。

【００５６】

次に、電圧印加と露光の開始時点をずらした場合に、明電流と暗電流を測定した結果を図１４に示す。露光時間、露光強度は図１２の場合と同様に、２０ｌｕｘ、３３ｍ秒間で、電圧印加は露光終了と同時に行い、２００Ｖの電圧を印加した。電圧印加開始前に、露光を終了した場合には、露光部分と未露光部分で導電性に違いがあることがわかる。

【００５７】

以上の２種類の電圧印加露光方法での電流測定したときの光誘起電流の測定結果を図１５に示す。２０ｌｕｘの光を３３ｍ秒間露光し、一方は露光開始と同時に、２００Ｖの電圧を印加し（Ａ）、他方は露光終了と同時に２００Ｖの電圧を印加した（Ｂ）。明電流と暗電流の差で表される光誘起電流は、露光と電圧印加の時点には関係なく、露光時間に依存し、電圧印加されている状態ではほぼ等しくなる。電圧印加開始は、露光開始と同時あるいは露光終了直後に行う必要はなく、露光中あるいは露光終了後しばらく時間が経過した後に電圧を印加しても同様の結果が得られる。

【００５８】

また、この例では光誘起電流の値がほぼ等しくなる場合を示したが、必ずしも光誘起電流が等しくなる場合のみではなく、露光と電圧印加時点により光誘起電流が異なる場合もあるが、このような場合でも光照射終了後、電圧印加したときに、未露光部に対して露光部の導電性が高くなる光センサは本発明の情報記録方法に使用することができる。

【００５９】

実施例２

電圧印加方法を以下のように変えた以外は実施例１と同様に光センサの特性を測定した。

【００６０】

２００Ｖの一定電圧を印加した場合と、２００Ｖの矩形波電圧を印加した状態で２０ｌｕｘ、３３ｍ秒の光で露光した場合の電流の測定結果を図１６に示す。矩形波は、５０ｍ秒間の電圧の印加の後に５０ｍ秒間電圧の印加を停止した後に再び電圧を印加することを繰り返し行った。

【００６１】

一定電圧を印加した場合の電流を破線で示し、矩形波の電圧を印加した場合の電流を実線で示した。

【００６２】

電圧が印加されていない状態では、電流は流れないが、２００Ｖの電圧を印加した場合には、一定電圧を印加した場合も、矩形波のパルス状の電圧を印加した場合も電流はほぼ等しくなり、電圧印加を停止し、再び電圧を印加したときにも２００Ｖの電圧を印加し続けた場合とほぼ等しい電流値を示す。

【００６３】

また、上記例では、パルス状の電圧を印加している間は電圧０である場合を示したが、パルス状の電圧を印加している間に逆極性の電圧を印加する場合でも、上記と同様に２００Ｖの電圧が印加されている状態では、一定電圧を印加したときと等しい電流値になり、逆極性の電圧が印加されている状態では、逆極性の電流が流れ、このときは露光部分と未露光部分の導電性に違いはみられない。

【００６４】

以上のように、一定電圧を印加した場合とパルス状の電圧を印加した場合と測定される電流がほぼ等しくなる場合に限らず、露光中、露光終了後を問わず、露光部分と未露光部分の導電性が異なり、未露光部分に比べて露光部分の導電性が高くなっているような光センサは本発明の情報記録方法に使用することができる。

【００６５】

実施例３

露光強度を１２１ｕｘ、露光時間を５００ｍ秒間とし、実施例２と同様に２００Ｖの一定電圧を連続的に印加した場合を破線で、５０ｍ秒間印加した後に５０ｍ秒間印加しない矩形波電圧を印加した場合を実線でそれぞれ図１７に示す。一定電圧を印加した状態では露光中は光誘起電流が増加することは、これまでの実施例と同様であるが、矩形波電圧をパルス状に印加した場合には、印加電圧が０Ｖの期間も露光中は光誘起電流が増加していることを示している。

【００６６】

実施例４

液晶記録媒体を情報記録媒体としたときの、光センサの情報記録性能を求めた。液晶記録媒体は図１８に表すように、抵抗（R_{LC}）とコンデンサ（C_{LC}）の並列回路とし表現することができ、光センサも抵抗（R_{PS}）とコンデンサ（C_{PS}）の並列回路として表現することができる。光センサの膜厚１０μｍ、液晶記録媒体の１ｃｍ^2 当りの容量：１０００ｐＦ、電気抵抗：１２０ＭΩ、光センサと液晶記録媒体との間隔を１０μｍ、光センサ側の電極と液晶記録媒体側の電極の間の印加電圧を７３０Ｖとし、２０ｌｕｘ、１／３０秒間露光した場合の測定結果から求めた結果を図１９に示す。

電圧印加直後は、電圧は、光センサと液晶記録媒体の容量の比に分配される。その後、光センサと液晶記録媒体の抵抗成分により電圧の分配が変化し、液晶記録媒体の電圧が増加する。露光部分と未露光部分では光センサの導電性が異なるため、未露光部分に比べて露光部分では液晶記録媒体により多くの電圧が印加されることとなる。

液晶記録媒体は、しきい値電圧以上になると、液晶が電界方向に配向し、透過率が増加する。その結果、未露光部分に比べて露光部分では液晶記録媒体の電圧が早くしきい値電圧に達するため、未露光部分の電圧がしきい値に到達し、配向を開始したときに電圧印加を停止すると、すでにしきい値以上の電圧が印加されて配向をした露光部分と未露光部分の透過率が異なり、電圧印加を停止した後もこの状態が維持されるために情報を記録することができる。

【００６７】

実施例５

６ｌｕｘの強度の光を２００ｍ秒間露光した後に、露光終了と同時に２００Ｖの電圧を印加した点を除いて実施例２と同様に、明電流と暗電流の差である光誘起電流を測定し、その結果を図２０に示す。また、液晶記録媒体への情報記録に有効な電圧印加開始後５０ｍ秒間の光誘起電流を斜線で示す。

【００６８】

実施例６

６ｌｕｘの強度の光を２００ｍ秒間露光し、露光開始後１５０ｍ秒後に２００Ｖの電圧を印加した点を除いて実施例５と同様に、明電流と暗電流の差である光誘起電流を測定し、その結果を図２１に示す。また、液晶記録媒体への情報記録に有効な電圧印加開始後５０ｍ秒間の光誘起電流を斜線で示す。

【００６９】

比較例１

６ｌｕｘの強度の光を２００ｍ秒間露光し、露光と同時に２００Ｖの電圧を印加した点を除いて実施例５と同様に、明電流と暗電流の差である光誘起電流を測定し、その結果を図２２に示す。また、液晶記録媒体への情報記録に有効な電圧印加開始後５０ｍ秒間の光誘起電流を斜線で示す。

長時間の露光によって２０ｌｕｘの光を３３ｍ秒間露光した場合と同等の光誘起電流を得ることができるが、電圧印加開始後５０ｍ秒間の光誘起電流を斜線で示すように斜線の部分の面積が、２０ｌｕｘの光を露光した場合や実施例５あるいは６に比べて少なく、充分なコントラストの画像の情報記録ができないことを示している。

【００７０】

実施例７

実施例４と同様に液晶記録媒体に印加される電圧を計算し、露光部と未露光部に電圧の差をシミュレーションした結果を図２３に示す。図において、ａは２０ｌｕｘ、３３ｍ秒間露光し、露光と同時に電圧を印加した場合、ｂは比較例１、ｃは実施例５、ｄは実施例６を示し、ｅは６ｌｕｘで２００ｍ秒間露光した場合

で、露光開始後１７５ｍ秒後に電圧印加した場合をそれぞれ示している。

液晶記録媒体のしきい値電圧を２００Ｖとすると、未露光部の液晶記録媒体の電圧は約６５ｍ秒後でしきい値電圧に達するために、この時間内に電圧印加を停止することによって情報を記録することができる。この場合の明部と暗部の電位差を比較することによって情報記録後のコントラストを推定することができる。図２３から、６５ｍ秒後における電位差を比較すると、ａに比べてｂの電位差は１／２程度であるため、大きなコントラストが得られないことがわかる。これに対して、ｃ、ｄ、ｅではａと同程度かそれ以上の電位差が得られる。また、ｄ，ｅは６５ｍ秒後には、同程度の電位差だが、ｄに比べてｅの印加電圧を高めに設定して、３０ｍ秒程度の電圧印加時間で情報記録を行うことにより、より大きなコントラストで情報記録を行うことができる。

【００７１】

次に、画像露光開始から電圧印加開始までの時間を変えることにより、記録画像のラチチュードを変える記録方法について説明する。

図２４は、本発明の光センサを使用し、電圧印加した状態で画像露光し、照射光強度を変化させたときの光誘起電流の測定結果を示すものである。光の照射時間は同様に３３ｍｓｅｃで測定した。露光強度は、△は４００Ｌｕｘ、＋は２００Ｌｕｘ、×は１２０Ｌｕｘ、□は８０Ｌｕｘ、○は４０Ｌｕｘ、●は２０Ｌｕｘである。

光誘起電流は光照射中増加し３３ｍｓｅｃ後に最大になる。この時の光誘起電流は光強度に依存し、光強度が強いほど光誘起電流も大きくなる。また、光照射後の減衰は、照射光強度が強いほど減衰速度が速く、照射光強度が弱い光の場合には緩やかに減衰することがわかる。このため、光照射終了後、一定時間経過したときの光誘起電流は、光照射終了直後に比べて、低露光強度における光誘起電流に対して、高露光強度における光誘起電流の割合が減少していることがわかる。

【００７２】

本発明の画像記録方法においては、このような光誘起電流の大きさに応じて液晶が配向するため、図２４の結果から、画像露光終了後、ある程度時間が経過し

た時に電圧印加すると、液晶の配向状態が低露光域と高露光域の差が小さくなることが予想できる。すなわち、ラチチュードが拡大することが予想される。

【００７３】

図２５はラチチュードを変えるための画像記録装置の構成を示し、本発明の光センサ１０と液晶記録媒体２０を約9ミクロンの厚さのポリイミドフィルムをスペーサにして空隙を介して対向配置した状態で画像記録装置に設置する。画像記録装置は、光源５１、レンズ５３、およびシャッタ５２を用いて透過原稿５４の透過画像を光センサ１０に露光することができる。また、画像記録装置は制御回路４０により、電源３０およびシャッタ５２を制御し、任意の時間、光センサに画像露光することができ、また、電源３０により任意の時間、両電力間に電圧印加することができる。また、電圧印加と画像露光のタイミングも任意に変化させることができる。

【００７４】

透過原稿は、ステップごとに光学濃度が０．１ずつ変化するグレースケールを用いた。図２６を用いて本実施例の電圧印加と画像露光のタイミングについて説明すると、画像露光時間をt_{eX}とし、画像露光開始から電圧印加開始までの時間をt_dとする。t_dを０～１２５ｍｓｅｃの範囲で変化させ、他の条件は同じにして画像記録を行った。このときの記録条件は、露光時間１／１２５秒、印加電圧７５０Ｖ、電圧印加時間５０ｍｓｅｃである。

【００７５】

これらの条件で画像記録を行い、記録した液晶記録媒体２０に対して読み取り光を照射し、透過光をＣＣＤセンサで読み取って露光量（グレースケールステップ）に対して、読み取り信号をプロットした結果を図２７に示す。図２７において、○はt_d＝０、×はt_d＝１２ｍｓｅｃ、△はt_d＝２８ｍｓｅｃ、□はt_d＝５０ｍｓｅｃ、◇はt_d＝１２５ｍｓｅｃである。

図２７より画像露光と同時に電圧印加をした場合（○）では、ステップ透過濃度が０．８程度で飽和してしまいラチチュードの狭い画像となり、画像露光から電圧印加までの時間が長いほど飽和濃度が大きくなり、ラチチュードが拡大することが分かる。

このように、画像露光に対して電圧印加開始のタイミングを遅らせて画像記録することにより、ラチチュードの広い条件で画像記録を行うことができる。時間t_dは、記録する被写体の状態や目的に合わせて選択すればよい。

【0076】

次に、本発明のシステムにおける画像記録の相反則不軌を補正する方法について説明する。

図1、図3で既に示したように、光センサの電流値は、露光中は、露光開始と同時に増加し、露光終了後も直ちに露光開始前の状態には戻らず、ゆっくりと減衰する。光センサの電流値は露光しない状態でも零ではなく、これをベース電流とすると、ベース電流との差が光誘起電流で、この差を利用して画像記録を行うことができる。なお、光誘起電流はベース電流に依存する性質があり、ベース電流が大きい（光センサの導電率が大きい）ほど光誘起電流も大きくなり、ベース電流が小さい（光センサの導電率が小さい）ほど光誘起電流は小さくなる。

本発明のシステムでは、このように露光終了後も光誘起電流が緩やかに減衰して流れ続けることを利用して、画像露光終了後もしばらくの間電圧印加を続けることにより、光誘起電流を有効に利用して、記録感度を高めることができる。

【0077】

また、図15で説明したように、電圧印加した状態で画像露光した場合（図のA）、画像露光後に電圧印加した場合（図のB）、電圧印加開始後は同じように光誘起電流が流れることが分かる。これは、電圧印加しなくても、露光することにより、光センサには電流を流れ易くする（抵抗値を低くする）前駆体が生成されているためであると考えられる。

【0078】

次に、露光時間を極端に長く（1秒）した場合の光誘起電流の測定結果を図28に示す。図示するように、露光開始直後は直線的に光誘起電流が増加するが、200msec付近から光誘起電流の増加量が急速に減衰し、約1秒後にほぼ飽和値に達している。図28の傾向は、前駆体についても同様である。

【0079】

次に、相反則、相反則不軌の測定について説明する。

図２５に示す光学系と画像露光装置を用いて相反則・不軌を測定した。なお、光センサへの入射光強度は、光源４０からの光をＮＤフィルタ（図示せず）を通し、この透過率を変えることにより調節した。

【００８０】

光センサと液晶媒体は、約１０μｍのフィルムをスペーサーにして、空気ギャップを介して対向配置し、光センサに画像露光し、電源３０により、両電極間に７００Ｖ、６０ｍｓｅｃ電圧印加して画像記録を行った。電源３０は制御装置４０により制御され、画像露光に対して、任意のタイミングで電圧印加する。

このような画像露光装置を用いて露光強度と画像露光時間を変化させ、階調特性、すなわち露光量－液晶媒体透過率との関係により相反則を調べた。なお、電圧印加条件が変化すると、階調特性が変化するため、電圧印加条件は同じにして測定した。

【００８１】

まず初めに、通常の画像露光・電圧印加条件で相反則・不軌を調べた。通常の電圧印加条件は、図２９に示すように、電圧印加と同時に画像露光を開始し、画像露光終了後も電圧印加を継続する方法で画像記録を行った。

電圧印加時間を６０ｍｓｅｃとし、露光時間を１／４００、１／１２５、１／６０、１／３０、１／１５ｓｅｃに対して、それぞれ露光量が等しくなるように露光強度を調整して画像記録を行った。記録した画像を専用の画像読み取り装置で測定した結果を図３０に示す。図の横軸は露光量の変化量、縦軸は読み取り信号強度である。なお、図３０には、１／４００ｓｅｃ（図の○）、１／１２５ｓｅｃ（図の□）、１／３０ｓｅｃ（図の＋）のみ示した。図３０における露光時間１／４ｓｅｃ（×印）、２．０ｓｅｃ（△印）は、後述する図３２に示すように、電圧印加時間は同じで、電圧印加開始前に露光した場合を示している。

【００８２】

１／１２５～１／３０ｓｅｃの範囲では、階調特性曲線が重なり、相反則が成り立っている。１／４００ｓｅｃの場合には低露光側に若干シフトしている。

【００８３】

また、電圧印加時間より短時間露光の場合には、露光終了後にも電圧印加を続

けることにより、光誘起電流を有効に利用することができるが、１／１５ｓｅｃの場合には、図３１（ａ）に示す電圧印加・露光方法であり、露光時間と電圧印加時間とがほぼ等しいため、光誘起電流を有効に活用できないため、特性曲線が高露光側にシフトしてしまい、相反則が成り立たない（相反則不軌）。

【００８４】

また、１／１５ｓｅｃ以上の長い露光、すなわち図３１（ｂ）の電圧印加・露光方法の場合には、電圧印加終了後の露光が全く無駄になってしまうため、露光時間が長くなるほど特性曲線が高露光側にシフトしてしまい、この領域では相反則不軌となる。

【００８５】

次に、相反則不軌補正方法について説明する。

〔露光時間が長い領域の補正方法〕

まず初めに、露光時間が長い領域の補正方法について説明する。

本発明のシステムで使用する光センサは、前述したように、電圧を印加しない状態で画像露光した場合でも、後に電圧印加することにより、光誘起電流が発生する特性を有している。このことを利用して、長時間露光する場合、図３２に示すように、電圧印加前に画像露光を開始しておいて、電圧印加終了前あるいは終了と同時に画像露光を終了することにより、電圧印加開始前の光を無駄にすることがなくなる。

【００８６】

図３１に示したように、電圧印加開始と同時に画像露光した場合と、図３２に示すように電圧印加前に画像露光し、電圧印加と画像露光を同時に終了させた場合の記録画像の読み取り信号を較した結果を図３３に示す。画像露光時間はどちらも2秒で、電圧印加条件は、７００Ｖ、６５ｍｓｅｃで行った。図中、○は図３２による電圧印加・露光方法、×は図３１（ｂ）に示す電圧印加・露光方法の場合である。なお、この○の特性は図３０の△の特性と同じである。

【００８７】

図から分かるように、電圧印加と同時に露光した場合には、電圧印加終了後の光が全く無駄になってしまうため、特性曲線が高露光側に大きくシフトし、また

、画像露光を電圧印加前に開始することにより、長時間露光であっても光センサの特性曲線の高露光側へのシフトを抑えることができた。このように、電圧印加開始前に露光することにより、特性曲線の高露光側へのシフトを防ぐ、換言すれば低露光側へシフトさせることができるので、電圧印加開始前の露光時間を調整することにより、相反則不軌の補正に利用することが可能である。

【００８８】

〔露光時間と電圧印加時間が等しい場合の補正方法〕

本発明のシステムでは、画像露光終了後も光誘起電流は直ちに零とはならずに、緩やかに減衰しながら流れるため、画像露光終了後も電圧印加を続けることにより、光誘起電流を効率良く利用することができる。このことから、露光時間と電圧印加時間がほぼ等しい場合でも、例えば電圧印加終了後に露光していて光誘起電流の有効利用ができていない場合は、感度が低下して特性曲線が高露光側にシフトする。このようなことを防ぐため、図３４に示すように、電圧印加開始前に画像露光を開始し、画像露光終了後も電圧印加を続けるようにする。このようにすれば、露光して光誘起電流がある程度大きくなるタイミングで電圧印加を開始すれば、光誘起電流の大きい時間帯で電圧印加することができ、高感度化することができる。

【００８９】

図３５にこのような方法で画像記録した結果を示す。

画像記録は、露光時間１／１５秒、電圧印加時間６５ｍｓｅｃ（印加電圧７００Ｖ）で行った。露光方法Ａは、図３１（ａ）に示す方法により、電圧印加と画像露光を同時に開始した場合（図の×印）、露光方法Ｂは図３４に示す方法により、画像露光開始後、約３０ｍｓｅｃ後に電圧印加を開始した場合（図の○印）である。図から分かるように、露光方法Ｂでは、露光方法Ａに比べて特性曲線が低露光側にシフトし、光誘起電流を有効に利用している結果が得られた。

【００９０】

次に相反則不軌の他の補正方法について説明する。

〔シャッタ速度・絞りによる補正方法〕

補正方法の他の方法は、特性曲線のずれをあらかじめ測定しておいて、シャッ

タースピードや絞り値を調整することで、適正な露光量で画像記録を行う方法である。

露光時間（シャッタースピード）を変化させて（1／400sec、1／250sec、1／125sec、1／60sec、1／30sec、1／15sec、1／8sec、1／4sec、1／2sec、1sec、2sec）画像記録を行った。露光時間が1／8sec以上の長時間露光の場合には、図32に示したように、電圧印加と画像露光を同時に終了するように電圧印加と露光のタイミングを調整し、電圧印加前に露光開始した。電圧印加時間は65msec（未露光部の電圧がしきい値電圧に達するまでの時間）で、露光時間1／15secの場合は、図34で説明したように、光誘起電流を有効利用するため露光時間開始後30msec後に電圧印加を開始する方法で画像記録を行った。

【0091】

主な結果は図30に示した通りである。露光時間1／250〜1／15secまでは、露光量に対する液晶媒体の透過率変化がほぼ等しくなり、この範囲で相反則が示された。1／15sec以上の長時間露光では、電圧印加開始前に画像露光した場合でも、露光時間が長くなるにつれて、特性曲線が高露光側にシフトする傾向が見られた。これは図28に示したように、露光時間が長くなると光誘起電流が直線的に変化せずに、増加量が減少するためと考えられる。しかし、シフト量は、電圧印加開始前の露光による補正で軽減されているため、約2秒露光の場合で0．4〜0．5log（Lux・sec）である。

【0092】

また、シャッタースピードが速い場合には特性曲線が低露光域側にシフトする傾向が見られる。

【0093】

これらの測定結果から、本発明のシステムでは高速および低速シャッター領域で相反則不軌でありこれを補正する必要がある。1／250〜1／15の広い範囲で、相反則が成り立つため、この特性に合わせるようにそれぞれ補正する必要がある。

【0094】

このような測定により相反則不軌の領域と、シフト量をあらかじめ測定しておき、その値に応じて、シャッタースピードや絞り値を調整することにより、適正な露光量で画像記録をすることができる。

【0095】

例えば、シャッタースピードが１／４秒の時のずれは０．２１ｏｇ（Ｌｕｘ・ｓｅｃ）であるため、１／１２５に比べて約４０％程度余計に露光すれば良い。

画像記録装置（カメラ）の絞りやシャッタースピードは任意の値を選ぶことができないため、十分に適正な露光量に制御することができない場合がある。

【0096】

この場合の補正方法について説明する。

【0097】

〔高速シャッターの場合〕

高速シャッターの場合、特性曲線が低露光域側にシフトするため、以下のように、画像露光と電圧印加のタイミングを変えることにより、補正することができる。高速シャッターでは、低露光側にシフトするため、露光量を減らすように補正すればよい。図３６（ｂ）に示すように、電圧印加と画像露光を同時にしないで、電圧印加開始前に画像露光し、光誘起電流が減衰したところで電圧印加を開始することにより、露光量を減らしたのと同じ効果が得られる。露光のタイミングは、図３０から得られるシフト量と、光誘起電流の減衰曲線からタイミングt_dを調整すれば良い。

【0098】

また、同様の方法で、t_dを変化させることにより、見かけの感度が変化するため、同じ露光条件に対して、任意に絞り値を設定することができる。例えば絞り値を開放したい場合にはt_dを長くすれば良い。

【0099】

〔電圧印加条件による補正〕

高速シャッターの場合の補正方法では長時間露光の補正ができない。

本発明のシステムでは電圧印加条件により、特性曲線を変化させることができ

る。

図３０に示したように、同一電圧印加条件で比較した場合、シャッタースピード１／４ｓｅｃでは、１／１２５ｓｅｃに比べて０．２１ｏｇ（Ｌｕｘ・ｓｅｃ）高露光側にシフトしている。

【０１００】

露光時間１／４ｓｅｃに対して、電圧印加条件を７２０Ｖ、６５ｍｓｅｃで画像記録した結果を図３７に示す。印加電圧を高めに設定したため、未露光部分の液晶媒体の透過率が増加している。図３８に、未露光部分の透過率と高露光部分の透過率の間で規格化した結果を比較すると、特性曲線が一致した。このように、電圧印加条件を制御して、未露光部分の液晶媒体の透過率を制御することにより、特性曲線を変化させることができる。高速シャッターの場合には、印加電圧を低めにするか、電圧印加時間を短めに設定することにより、特性曲線を高露光側にシフトすることができ、補正することができる。

【０１０１】

〔シンクロ撮影方法〕

前述したように、本発明のシステムでは、電圧印加開始前に画像露光することにより、弱い光でも長時間露光することにより、画像記録することができる。このことを利用して、例えば、夜景を背景にして人物をフラッシュ光で撮影するようなことが可能である。図３９に示すように、長時間シャッターで主に背景を画像露光をしている途中で、フラッシュを発光すると同時に電圧印加することにより、夜景と人物を同時に撮影することが可能である。この場合電圧印加とフラッシュ光を同期させることが望ましく、フラッシュの発光後に電圧印加を開始すると、フラッシュ光を有効に利用できない。また、電圧印加を開始する十分前に画像露光をしないと、背景を明るく記録することができない。

【０１０２】

なお、図２８に示したように、画像露光時間が長い（約１．５～２秒）と、光誘起電流が飽和してしまい変化しなくなる。このため、それ以上長い時間電圧印加・画像露光しても、有効に画像記録することができない。そこで、光誘起電流が飽和するような長時間露光で画像記録する場合には、図４０に示すように、画

　出証特平０７－３０２７０５８

像露光開始後、光誘起電流が飽和になる時間で電圧印加を行い（４０～５０ｍｓｅｃ程度）、電圧印加停止後、一定時間経過し、光センサ、液晶媒体各層の電圧が十分減衰した状態で、再び電圧印加することにより、有効に画像記録することができる。なお、図４０では電圧印加を２回行う場合の例について示したが、電圧印加の回数に制限はなく、露光時間に応じて複数回電圧印加してもよい。

【０１０３】

次に、本発明の画像露光方法による装置構成の概略について説明する。

図４１は、本発明の画像記録装置の概略構成を示す図である。図中、１０１～１０３は、本発明の画像記録に必要な各種測定手段であり、１０１は測光手段、１０２は光センサのベース電流および／または液晶媒体の抵抗値等の物性値測定手段、１０３はシャッター時間および／または絞り等の撮影条件の入力手段である。なお、ベース電流、液晶媒体の抵抗値等の物性値が予め既知の場合は、入力手段１０３から設定することも可能である。１０４はマイクロコンピュータ等からなる制御装置であり、測光手段１０１で測定された光強度、測定手段１０２の測定結果（あるいは入力された光センサ、液晶媒体の物性値）に基づいてシャッター時間を算出・設定し、また、電圧印加条件（印加電圧、電圧印加時間）を設定する。制御装置１０４は、設定したシャッター時間と電圧印加条件に適したタイミング（方法）で電源３０およびシャッター７０を制御し、光センサ１０、液晶媒体２０への電圧印加・露光を制御して最適条件で撮影する。なお、７１はレンズである。

【０１０４】

次に、電圧印加開始前に露光する方法を用いたカメラ及びその動作シーケンスについて説明する。

図４２は本発明の電圧印加・画像露光方法を適用したカメラの一実施例を説明する図である。

本実施例では一眼レフカメラ６０に回転式のシャッタ６７を組み込み、従来のフィルムの代わりに液晶記録媒体を使用するようにした例である。ミラー６２は、図示しない電源スイッチをＯＮ／ＯＦＦするのに連動して図の実線の位置と破線の位置に回動し、図の実線の位置において撮影レンズ６１からの光をミラー６

２、ペンタプリズム６４で方向を変え、接眼レンズ６５を通して被写体を観察し、ピント合わせ等を行えるようになっている。撮影時に電源スイッチをＯＮすると、ミラー６２が破線の位置に跳ね上げられ、被写体からの光は撮影レンズ６１、フィルタ６８、回転式シャッタ６７を通して媒体ホルダ６９に照射される。回転式シャッタ６７及び媒体ホルダ６９は制御装置６６で連動して動作する。

【０１０５】

媒体ホルダ６９は、図４３に示すように、光センサ１０と液晶記録媒体２０をスペーサ１６により約９μｍの空隙を介して対向させて保持しており、光センサ１０と液晶記録媒体２０の両電極間に光センサが正になるように電圧印加して光センサの支持体側から画像露光するように構成されている。なお、液晶記録媒体としては、光センサ上に直接或いは中間層を介して液晶層、電極層が形成された一体型のものであってもよい。

【０１０６】

図４４は、撮像シーケンスの１例を示し、ミラー（撮影光学系）または記録媒体を移動させ、シャッタを３回開閉して電圧印加前に画像１、画像２を露光し、電圧印加後に画像３を露光している。このようなシーケンスで、媒体の異なる位置に画像１～３を記録することができる。

【０１０７】

図４５は画像１～３の露光中、シャッターを開けている以外は図４４の場合と同じであり、同様に媒体の異なる位置に画像１～３を記録することができる。

【０１０８】

図４６はストロボ発光による撮像シーケンスを示し、図４５と同様なシーケンスで３回のストロボ発光を行って画像記録がなされる。

【０１０９】

【発明の効果】

本発明の光センサは、情報光の露光の後に、光センサの電極と情報記録媒体との電極間に電圧を印加するか、情報光を露光した状態で光センサの電極と情報記録媒体との電極間に印加する電圧を断続化、あるいは電圧の印加を停止した後に再度電圧の印加を行うようにしたので、未露光部と露光部の導電性の差が大きい

ので、液晶によって記録する場合にも未露光部の電圧が液晶のしきい値電圧以上には上昇しないので、弱い光による長時間露光によってもコントラストの大きな情報を記録することができる。

また、本発明は、電圧印加開始前に画像露光することにより、記録画像のラチチュードを変えたり、また、記録感度を補正することができるので、カメラに必要な相反則を成り立たせるような補正を行うことも可能となる。

【図面の簡単な説明】

【図１】

電圧の印加と露光を同時に行う光センサ電流測定結果を示す図である。

【図２】

液晶とそれを保持する樹脂からなる情報記録媒体をコンデンサと抵抗の並列回路とした時の液晶記録層に印加される電圧を露光部と未露光部についてのシミュレーションの結果を示す図である。

【図３】

２００Ｖの電圧を印加した状態で６１ｕｘの光を２００ｍ秒間露光したときの電流値を測定した結果である。

【図４】

６１ｕｘで露光したときの露光部分と未露光部分の電流値の差を示す図である。

【図５】

２０１ｕｘで露光したときの露光部分と未露光部分の電流値の差を示す図である。

【図６】

光センサを説明するための断面図である。

【図７】

本発明の方法に使用する情報記録装置を説明する断面図である。

【図８】

本発明の情報記録装置への情報記録方法について説明する図である。

【図９】

繰り返し電圧印加した場合の液晶記録層および光センサに印加される電圧の変化の一例を説明する図である。

【図１０】

多重露光による画像情報を記録する方法を説明する図である。

【図１１】

本発明の光センサの特性の測定方法を説明する図である。

【図１２】

光センサの電気的特性を説明する図である。

【図１３】

明電流と暗電流との差で表される光誘起電流を説明する図である。

【図１４】

電圧印加と露光の開始時点をずらした場合に、明電流と暗電流を測定した結果を説明する図である。

【図１５】

異なる電圧印加露光方法での電流測定したときの光誘起電流の測定結果を説明する図である。

【図１６】

一定電圧を印加した場合と矩形波電圧を印加した状態で露光した場合の光誘起電流の測定結果を説明する図である。

【図１７】

一定電圧を印加した場合と矩形波電圧を印加した状態で露光した場合の他の例の光誘起電流の測定結果を説明する図である。

【図１８】

液晶記録媒体の等価回路を説明する図である。

【図１９】

光センサの情報記録性能を説明する図である。

【図２０】

露光終了後に電圧を印加した場合の光誘起電流の測定結果を説明する図である

。

【図２１】

露光終了後に電圧を印加した場合の光誘起電流の他の測定結果を説明する図である。

【図２２】

露光終了後に電圧を印加した場合の光誘起電流の他の測定結果を説明する図である。

【図２３】

露光部と未露光部に電圧の差をシミュレーションした結果を説明する図である。

【図２４】

電圧印加した状態で画像露光し、照射光強度を変化させたときの光誘起電流の測定結果を示す図である。

【図２５】

ラチチュードを変えるための画像記録装置の構成を示す図である。

【図２６】

画像露光開始から電圧印加開始までの時間を変える画像記録方法を説明する図である。

【図２７】

図２６の方法で画像記録したときの測定結果を示す図である。

【図２８】

露光時間を長くした場合の光誘起電流の測定結果を示す図である。

【図２９】

電圧印加中に画像露光する記録方法を示す図である。

【図３０】

相反則不軌を説明する図である。

【図３１】

電圧印加中又は電圧印加後も露光継続する電圧印加・露光方法を説明する図である。

【図３２】

電圧印加開始前に画像露光を開始する電圧印加・露光方法を説明する図である。

【図３３】

電圧印加同時露光と電圧印加前に画像露光した場合の読み取り信号の測定結果を示す図である。

【図３４】

電圧印加開始前に画像露光する記録方法を示す図である。

【図３５】

電圧印加同時露光と電圧印加開始前に画像露光した場合の読み取り信号の測定結果を示す図である。

【図３６】

画像露光から電圧印加開始までの時間を変化させる電圧印加・露光方法を説明する図である。

【図３７】

印加電圧を高く設定した場合の読み取り信号の測定結果を示す図である。

【図３８】

図３７において、未露光部分と露光部分の透過率の間で規格化した結果を示す図である。

【図３９】

シンクロ撮影方法を説明する図である。

【図４０】

長時間画像露光中に複数回電圧印加をする記録方法を示す図である。

【図４１】

本発明の画像記録装置の構成を示す図である。

【図４２】

本発明の記録方法を適用したカメラを示す図である。

【図４３】

媒体ホルダを示す図である。

【図４４】

画像シーケンスの１例を示す図である。

【図４５】

画像シーケンスの他の例を示す図である。

【図４６】

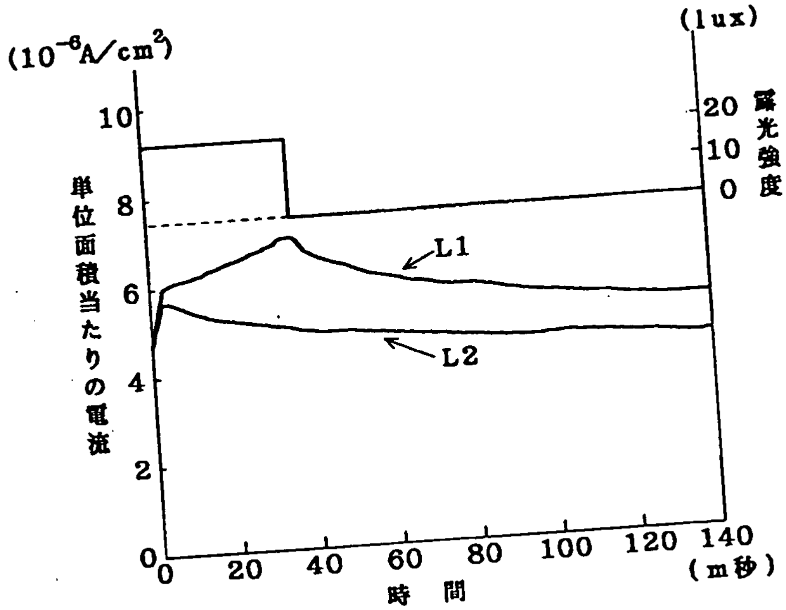
画像シーケンスの他の例を示す図である。

【符号の説明】

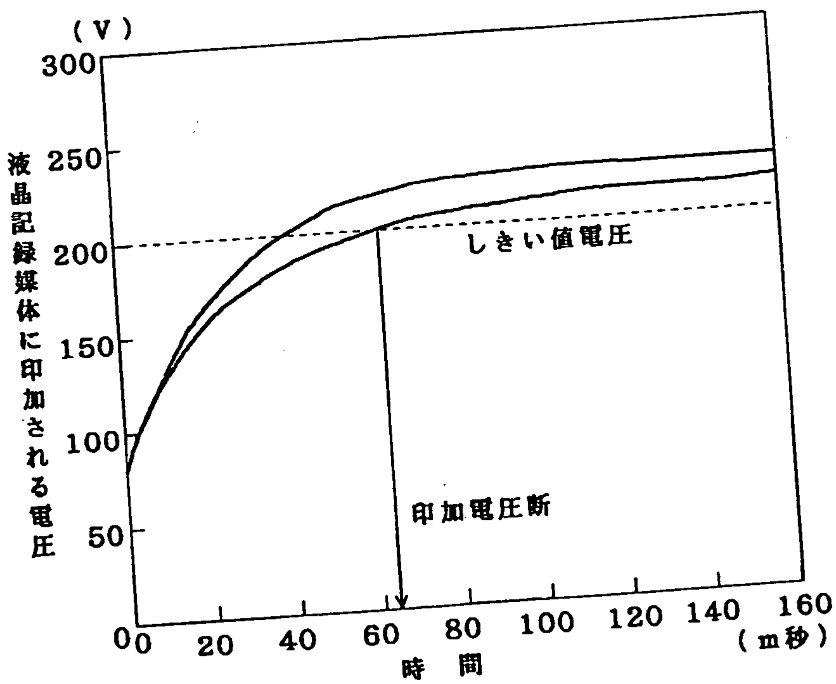
１０…光センサ、１１…基板、１２…電極、１３…光導電層、１４…電荷発生層、１５…電荷輸送層、１６…スペーサ、１７…情報光、１８…制御装置、２０…情報記録媒体、２１…基板、２２…電極、２３…情報記録層、３１…金電極、３２…光源、３３…フィルター、３４…パルス発生装置、３５…シャッター、３６…電源、３７…オシロスコープ、４０…制御回路、５２…シャッター、６０…カメラ、７０…光学シャッター、１０１…測光手段、１０２…ベース電流測定手段、１０３…入力手段、１０４…制御装置。

【書類名】　図面

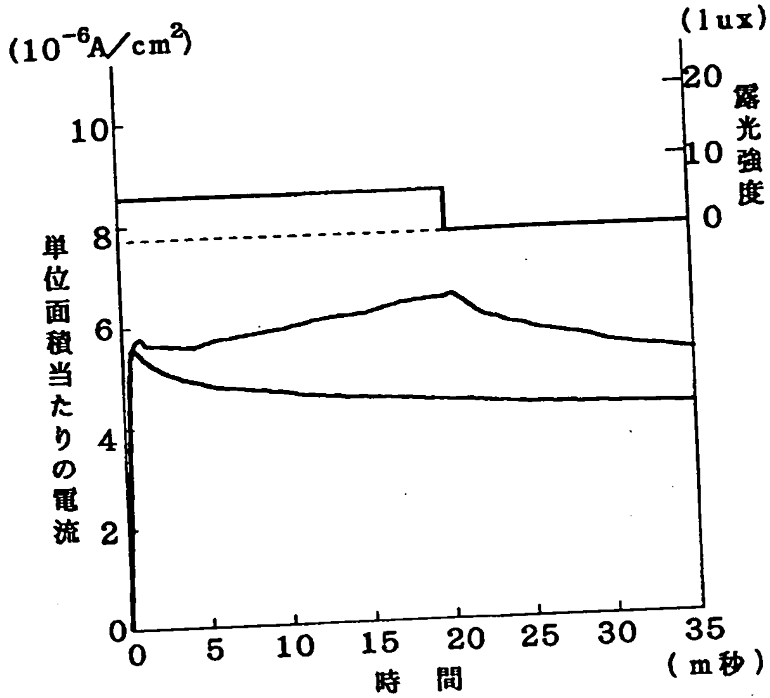
【図１】


(10⁻⁶A/cm²)
(lux)
単位面積当たりの電流
露光強度
L1
L2
時　間
(m秒)
10
8
6
4
2
0
20
10
0
0
20
40
60
80
100
120
140

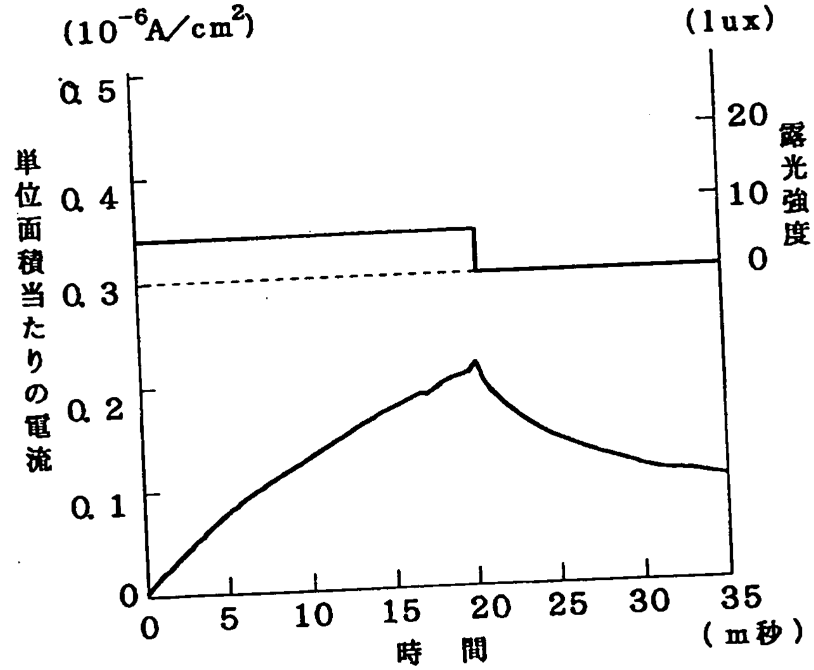
【図２】


(V)
液晶記録媒体に印加される電圧
しきい値電圧
印加電圧断
時　間
(m秒)
300
250
200
150
100
50
0
0
20
40
60
80
100
120
140
160

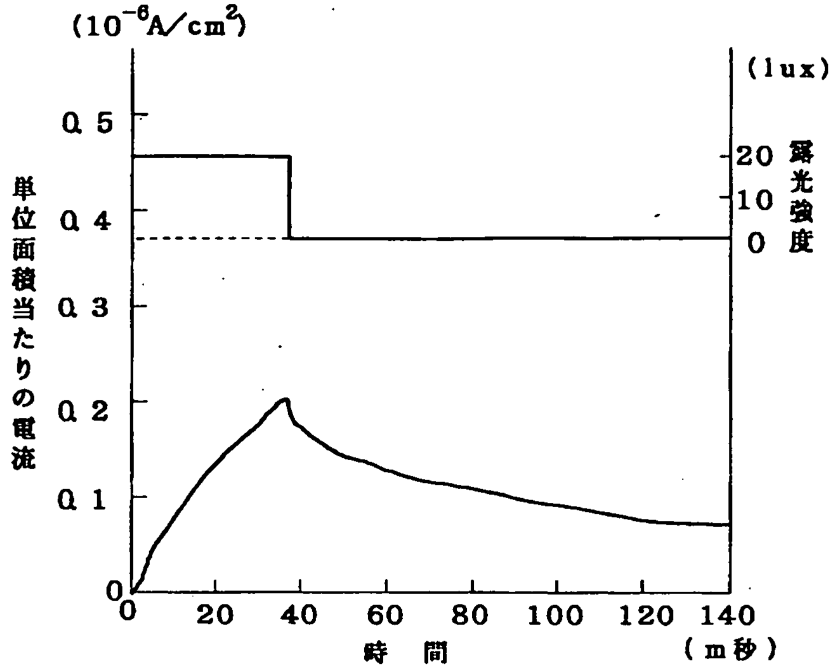
【図３】


(10⁻⁶A/cm²)
(lux)
20
10
0
露光強度
10
8
6
4
2
0
単位面積当たりの電流
0 5 10 15 20 25 30 35
(m秒)
時間

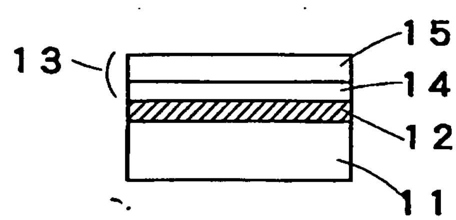
【図４】


(10⁻⁶A/cm²)
(lux)
0.5
0.4
0.3
0.2
0.1
0
単位面積当たりの電流
20
10
0
露光強度
0 5 10 15 20 25 30 35
(m秒)
時間

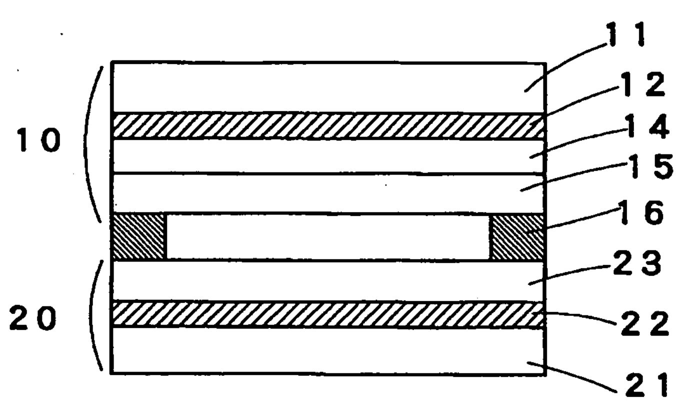
【図５】


(10^-6 A/cm^2)
(lux)
0.5
0.4
0.3
0.2
0.1
0
20
10
0
露光強度
単位面積当たりの電流
0
20
40
60
80
100
120
140
時間
(m秒)

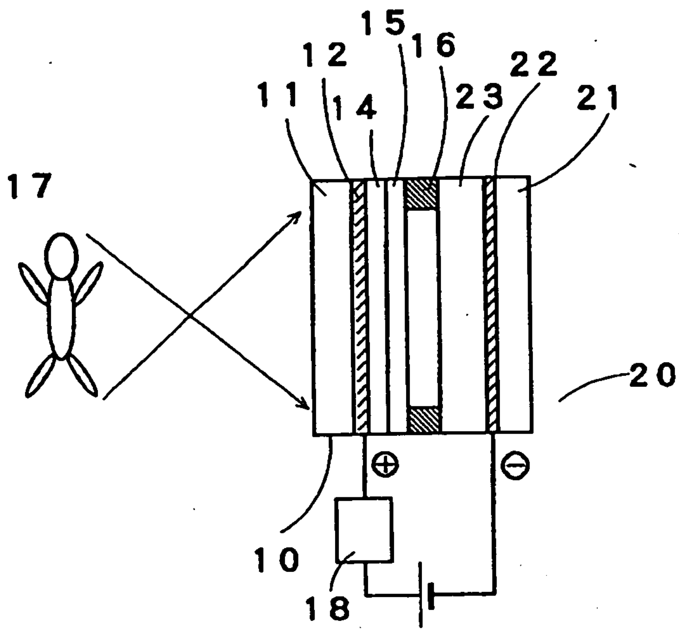
【図６】


13
15
14
12
11

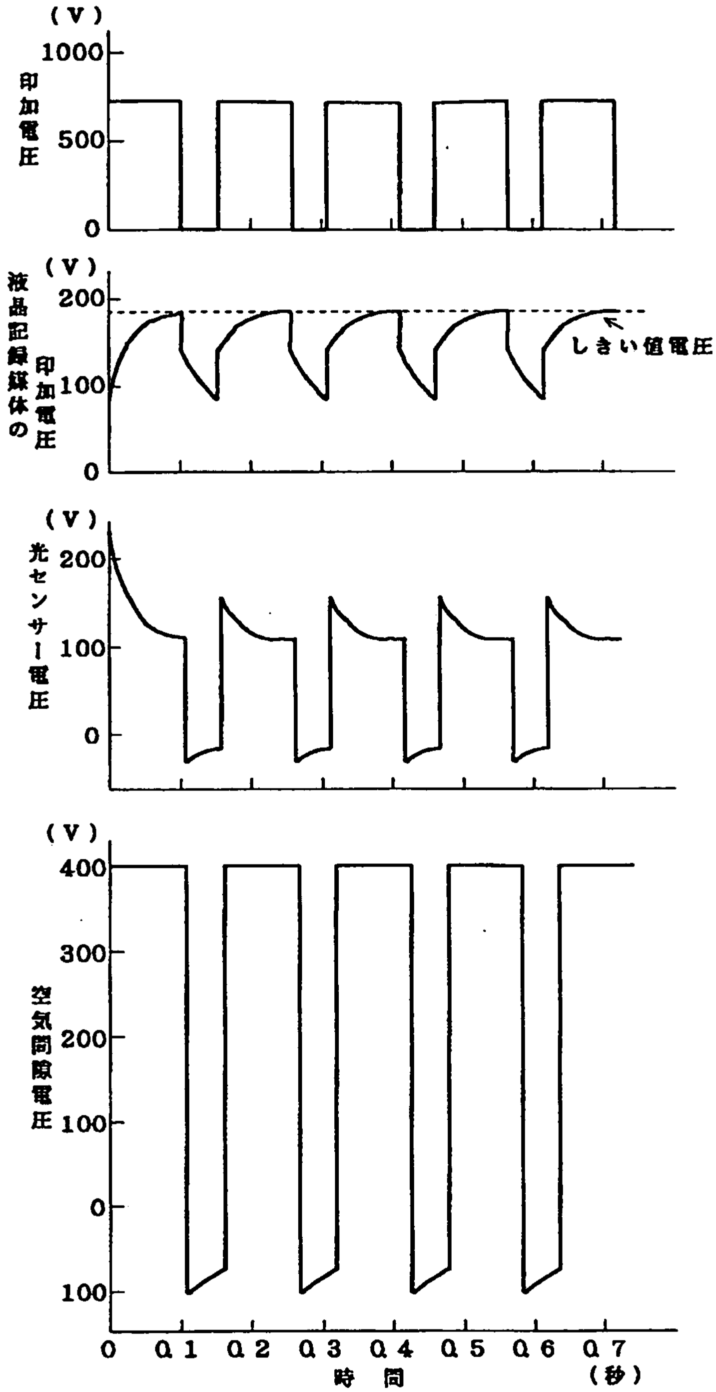
【図７】


10
20
11
12
14
15
16
23
22
21

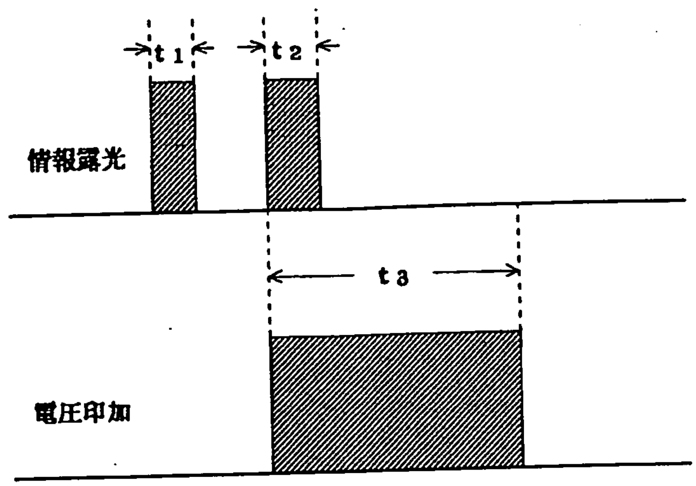
【図８】



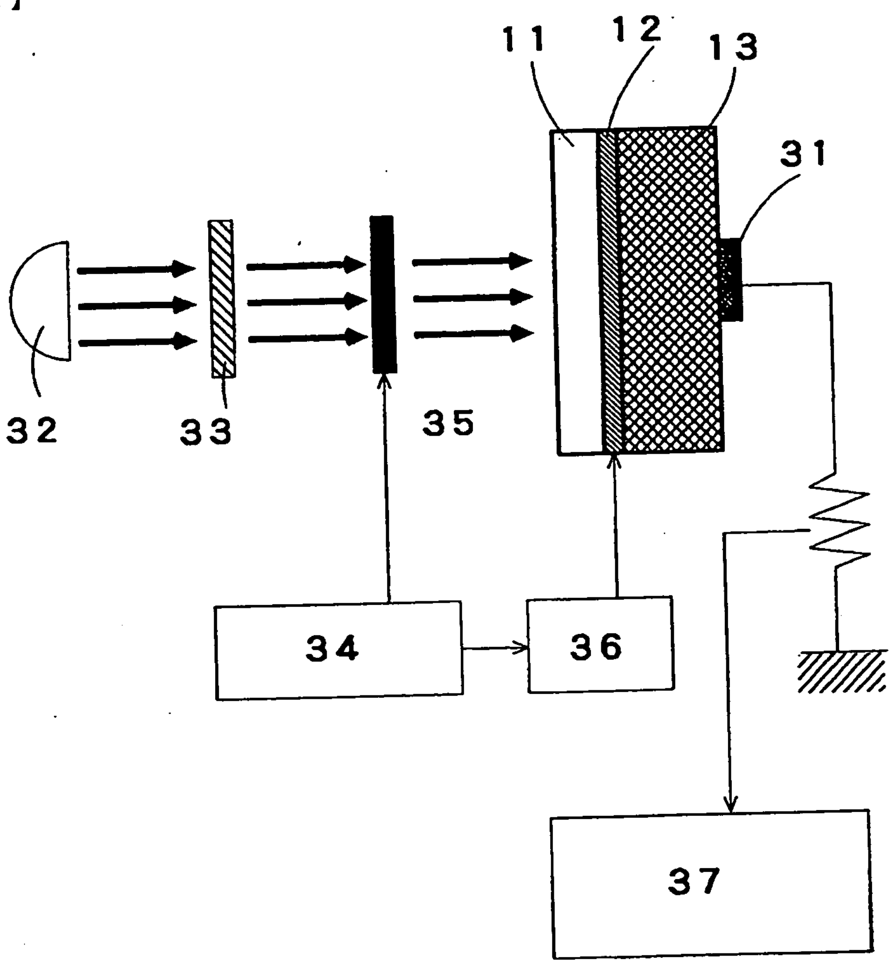
【図９】


(V)
1000
印加電圧
500
0
(V)
200
液晶記録媒体の印加電圧
100
0
しきい値電圧
(V)
200
光センサー電圧
100
0
(V)
400
300
空気間隙電圧
200
100
0
100
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
時間
(秒)

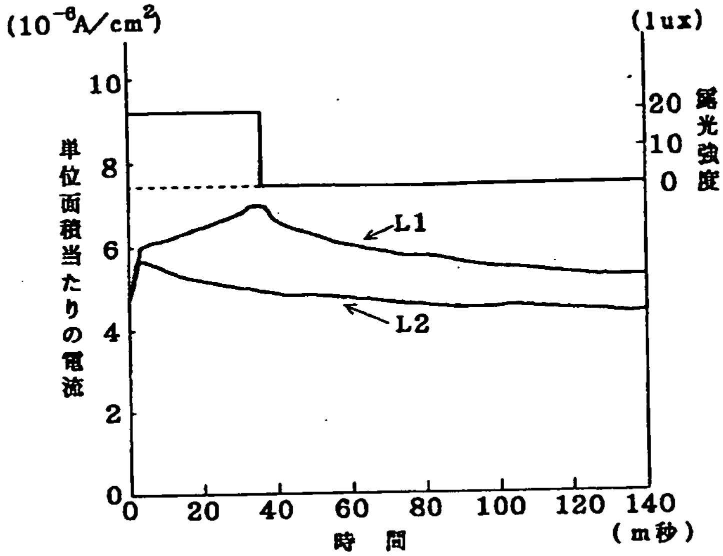
【図１０】



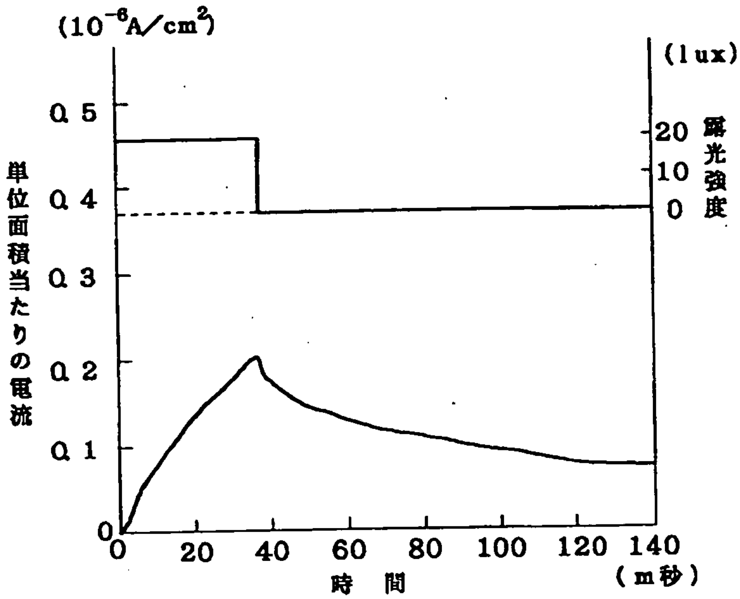
【図１１】



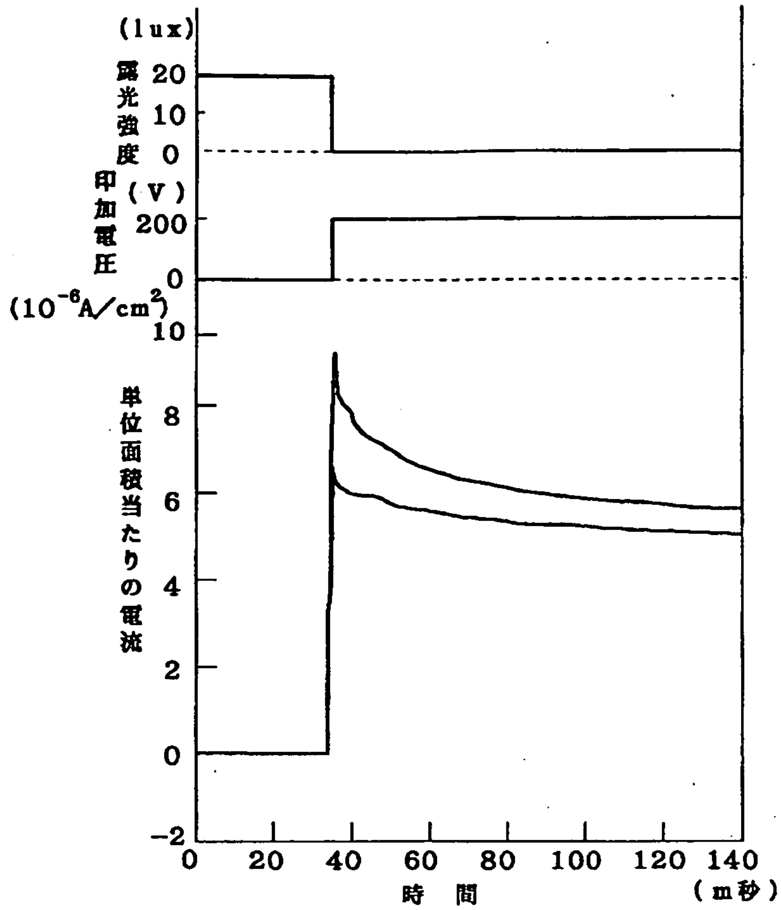
【図１２】


(10⁻⁶A/cm²)
(lux)
10
8
6
4
2
0
単位面積当たりの電流
20
10
0
露光強度
L1
L2
0
20
40
60
80
100
120
140
(m秒)
時　間

【図１３】

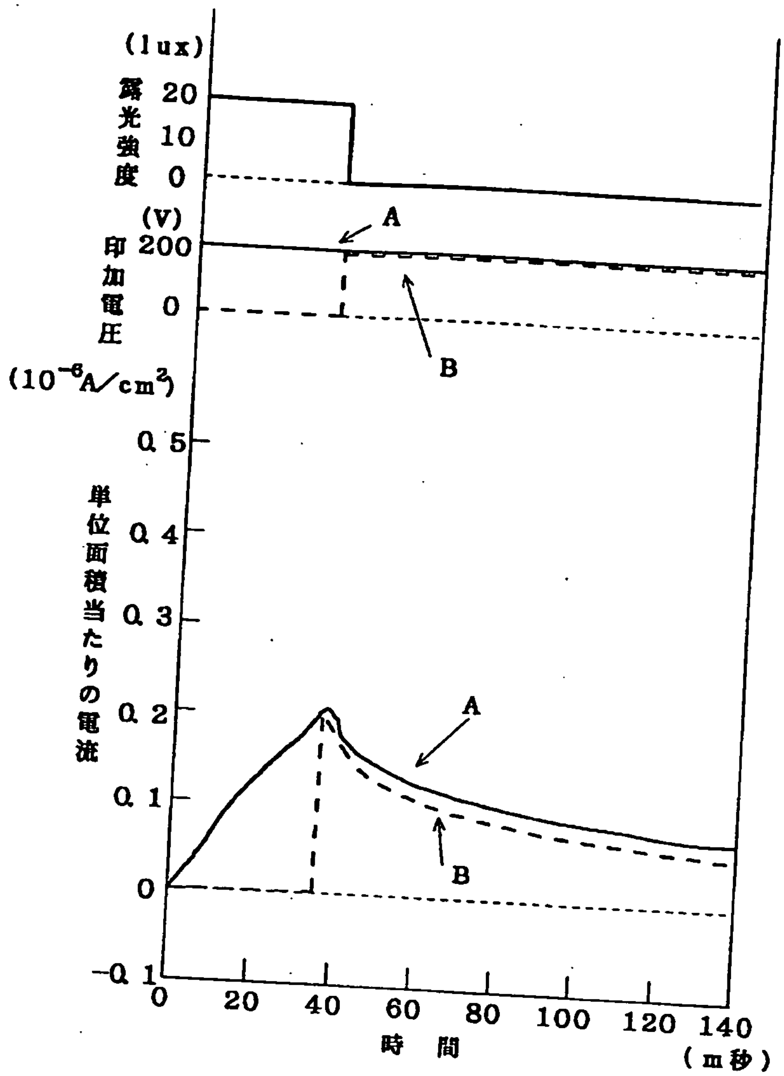

(10⁻⁶A/cm²)
(lux)
0.5
0.4
0.3
0.2
0.1
0
単位面積当たりの電流
20
10
0
露光強度
0
20
40
60
80
100
120
140
(m秒)
時　間

14】

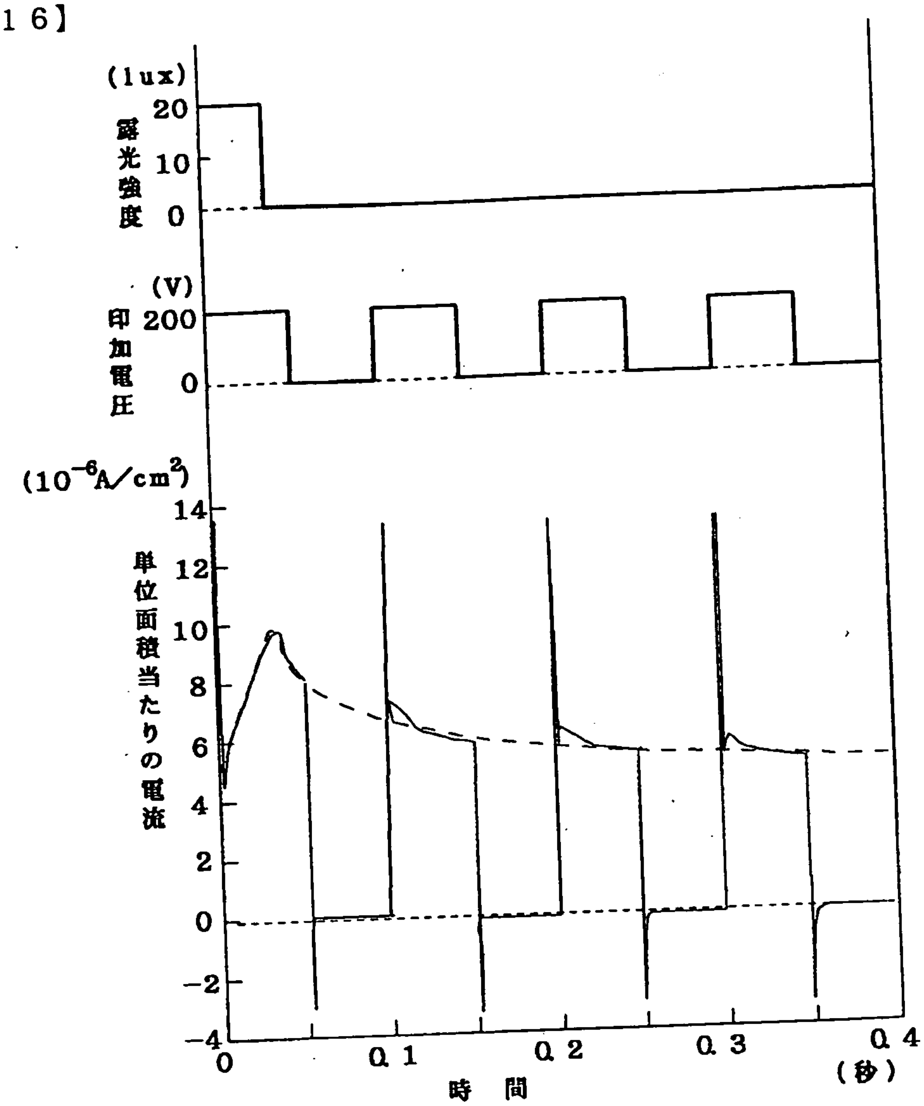


(lux)
露光強度
20
10
0
印加電圧
(V)
200
0
(10⁻⁶A/cm²)
単位面積当たりの電流
10
8
6
4
2
0
−2
0
20
40
60
80
100
120
140
時間
(m秒)

【図5】

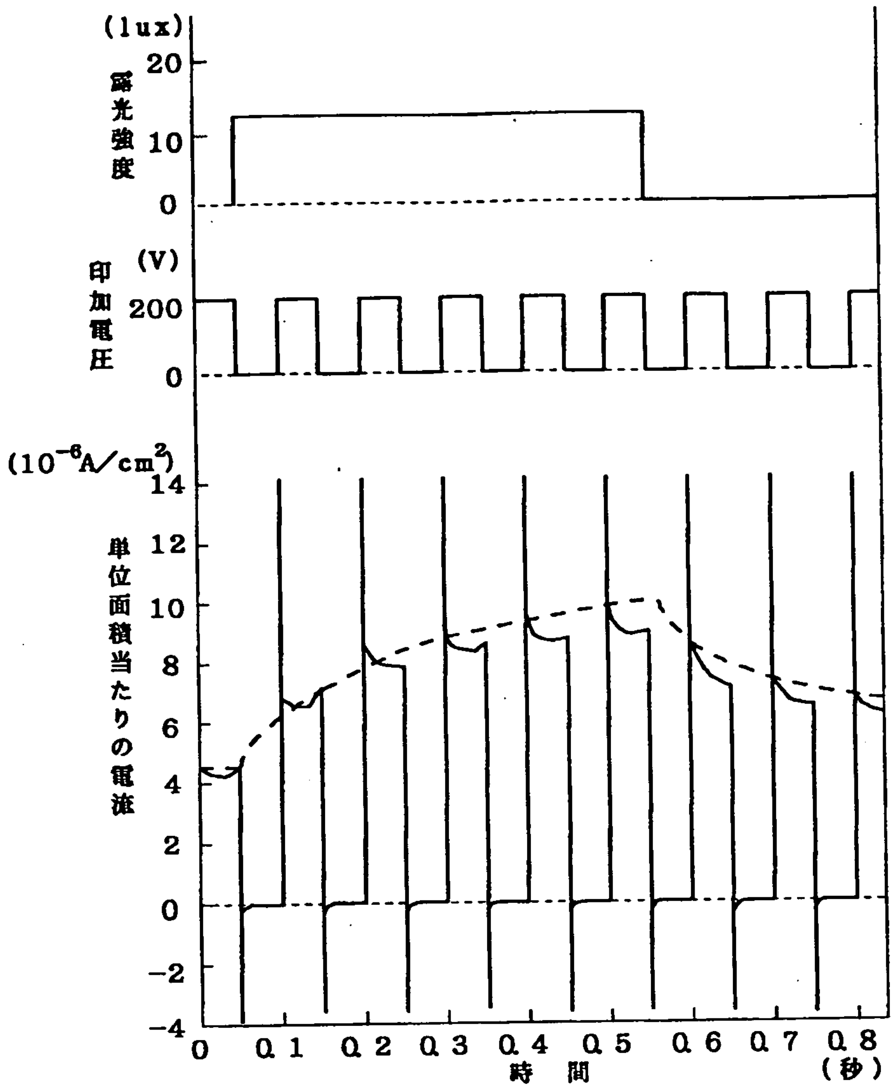

(lux)
露光強度
20
10
0
(V)
印加電圧
200
0
A
B
(10^{-6}A/cm^2)
単位面積当たりの電流
0.5
0.4
0.3
0.2
0.1
0
−0.1
A
B
0
20
40
60
80
100
120
140
時間
(m秒)

【図１６】

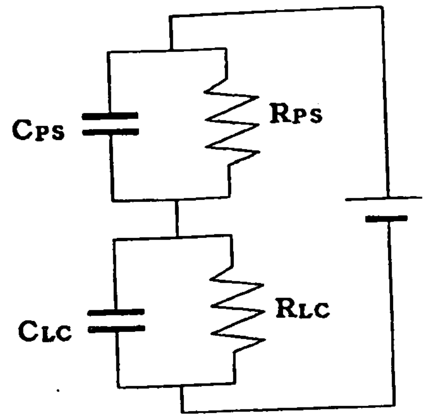


出証特平０７−３０２７０５８

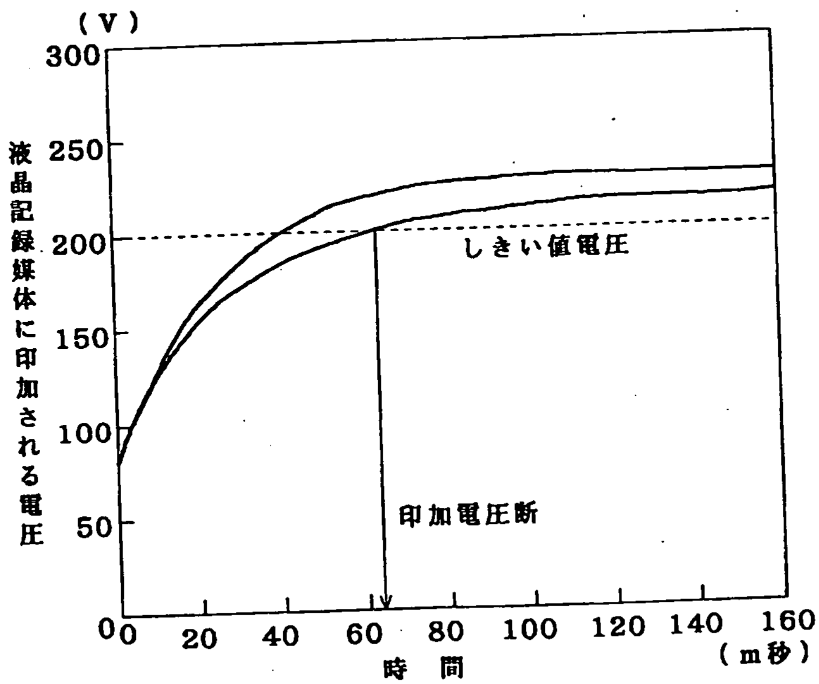
【図１７】


(lux)
露光強度
20
10
0
印加電圧
(V)
200
0
(10^{-6}A/cm^2)
単位面積当たりの電流
14
12
10
8
6
4
2
0
−2
−4
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
時間
(秒)

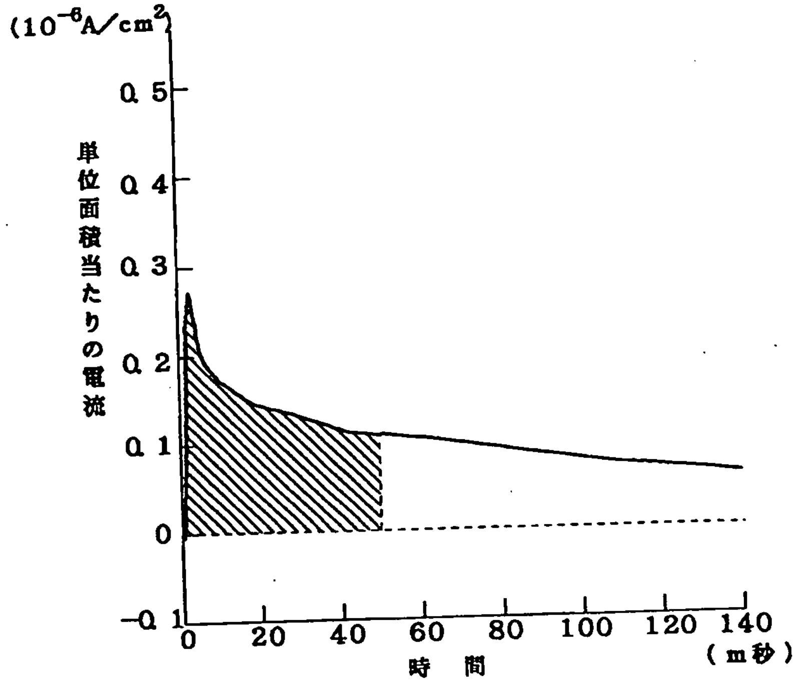
【図１８】


CPS
RPS
CLC
RLC

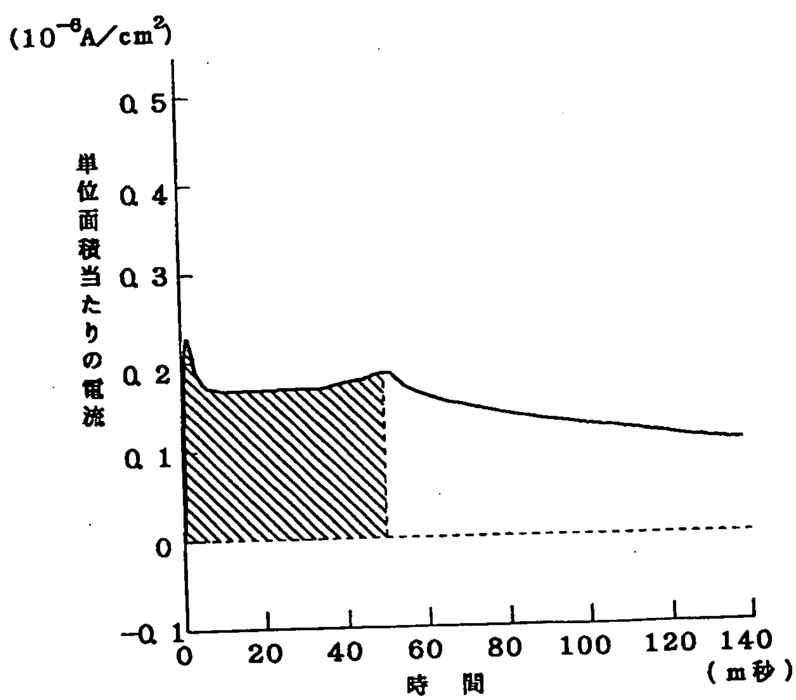
【図１９】


(V)
300
250
200
150
100
50
0
液晶記録媒体に印加される電圧
しきい値電圧
印加電圧断
0
20
40
60
80
100
120
140
160
(m秒)
時 間

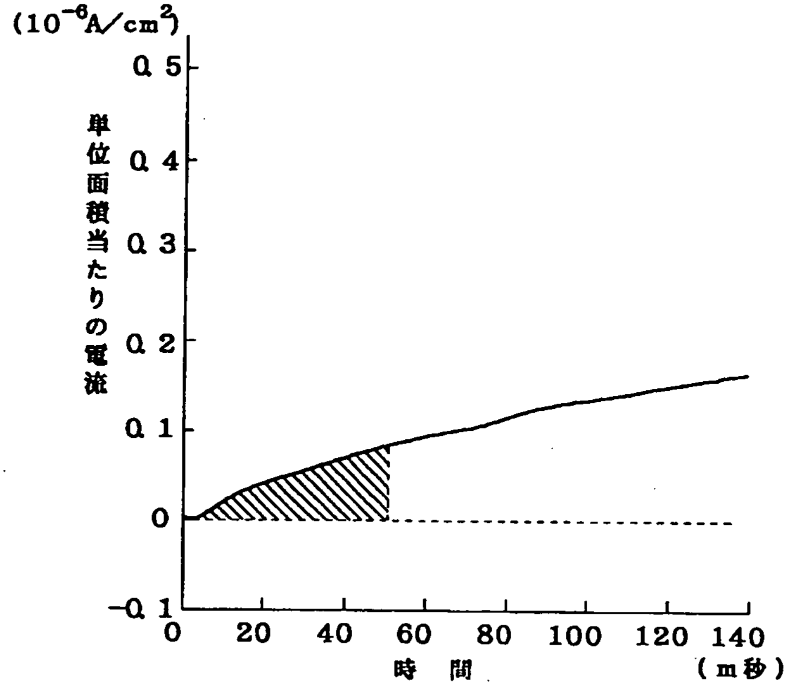
【図２０】


(10^{-6}A/cm^2)
単位面積当たりの電流
0.5
0.4
0.3
0.2
0.1
0
−0.1
0
20
40
60
80
100
120
140
(m秒)
時　間

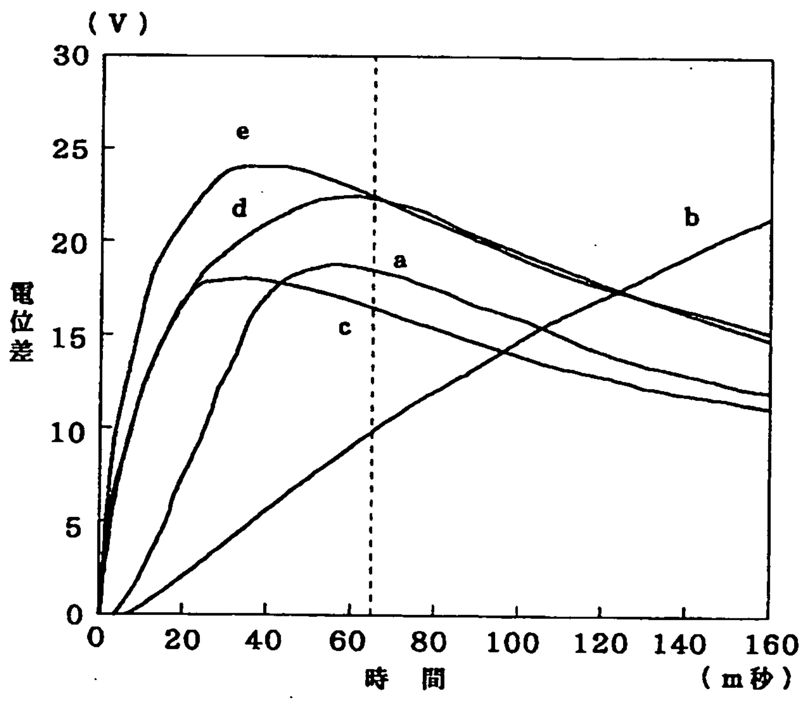
【図２１】


(10^{-6}A/cm^2)
単位面積当たりの電流
0.5
0.4
0.3
0.2
0.1
0
−0.1
0
20
40
60
80
100
120
140
(m秒)
時　間

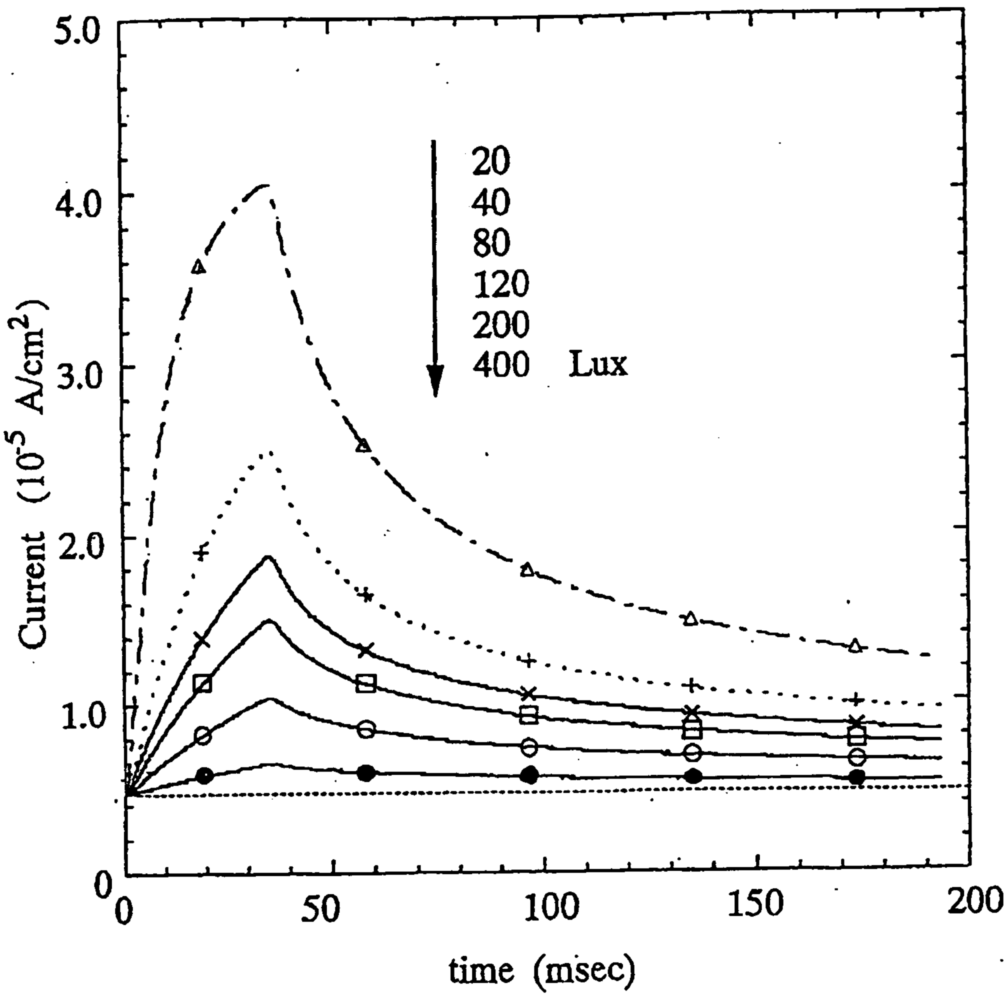
【図２２】


(10⁻⁶A/cm²)
単位面積当たりの電流
0.5
0.4
0.3
0.2
0.1
0
−0.1
0
20
40
60
80
100
120
140
時　間
(m秒)

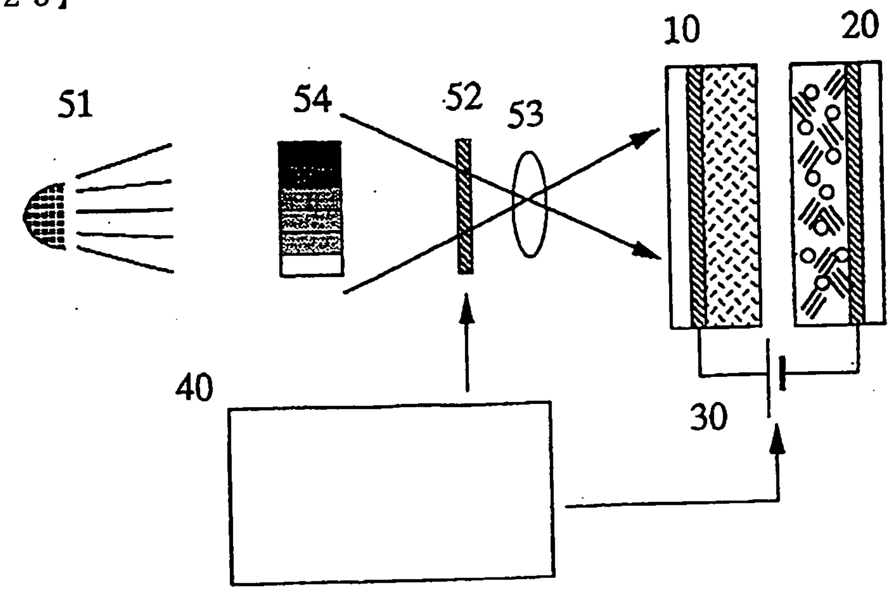
【図２３】


(V)
30
25
20
15
10
5
0
電位差
e
d
a
c
b
0
20
40
60
80
100
120
140
160
時　間
(m秒)

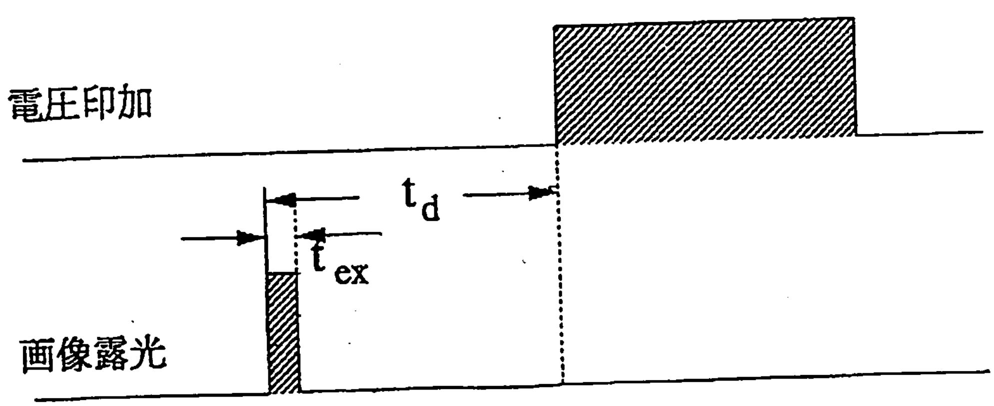
【図２４】


5.0
4.0
3.0
2.0
1.0
0
Current (10^{-5} A/cm^2)
20
40
80
120
200
400 Lux
0
50
100
150
200
time (msec)

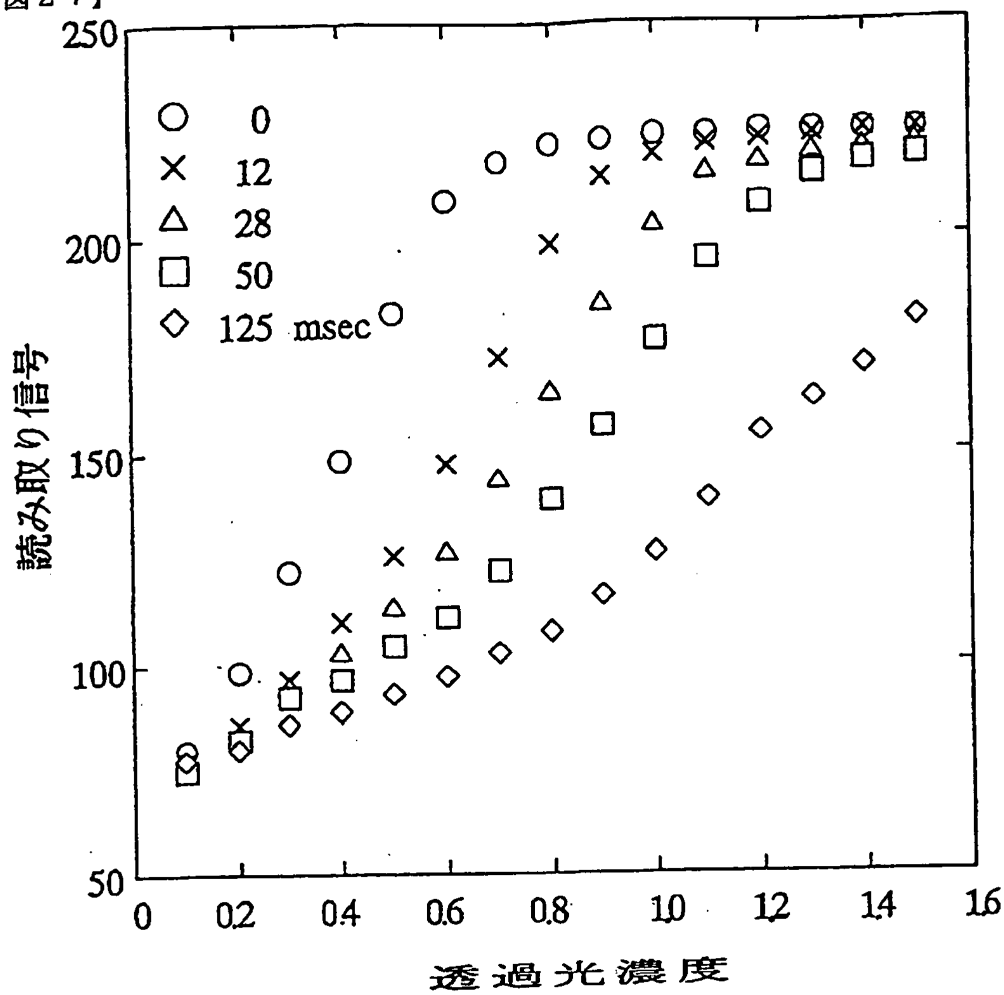
【図２５】



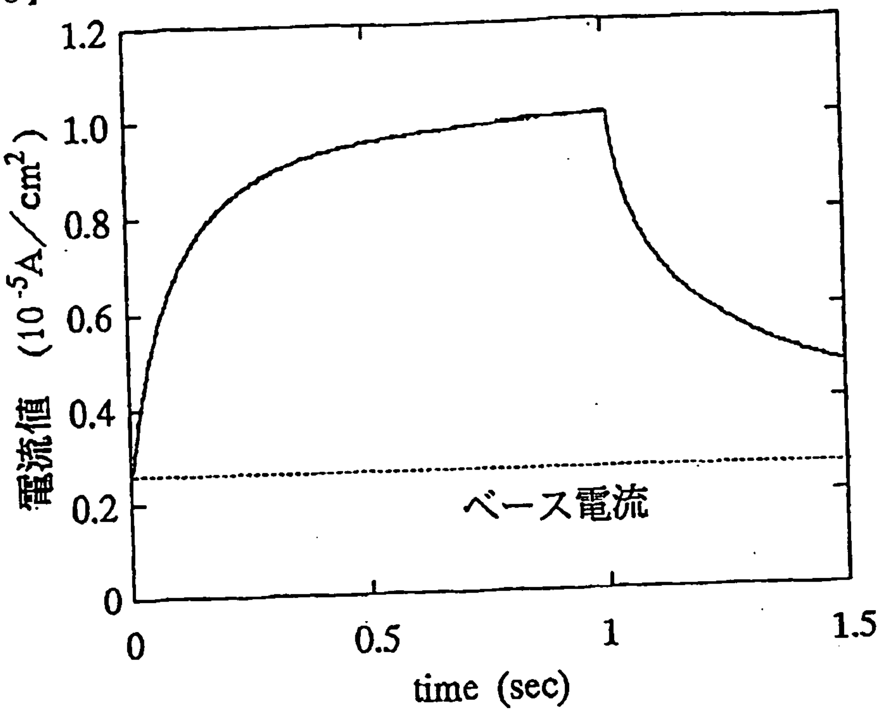
【図２６】



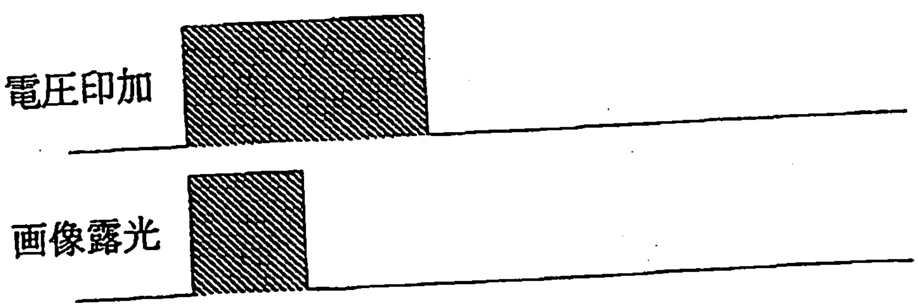
【図２７】


0
12
28
50
125 msec
読み取り信号
250
200
150
100
50
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
透過光濃度

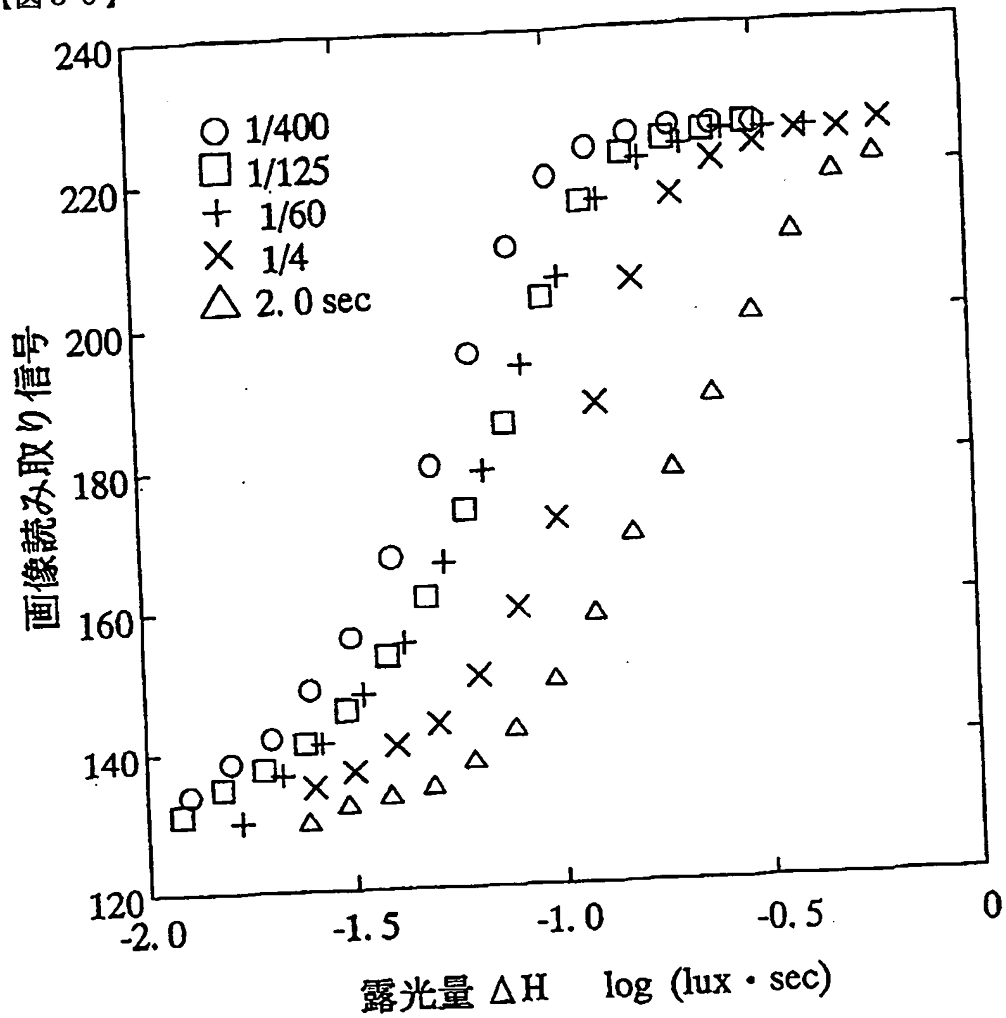
【図２８】



【図２９】

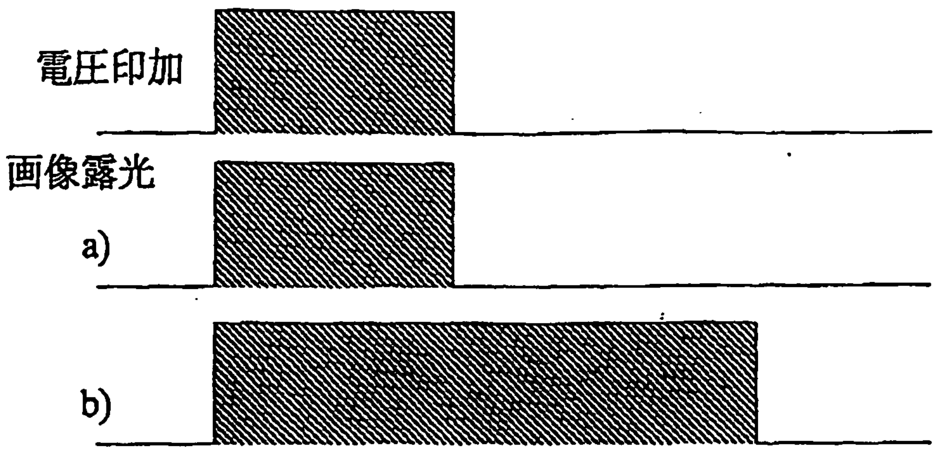


【図３０】

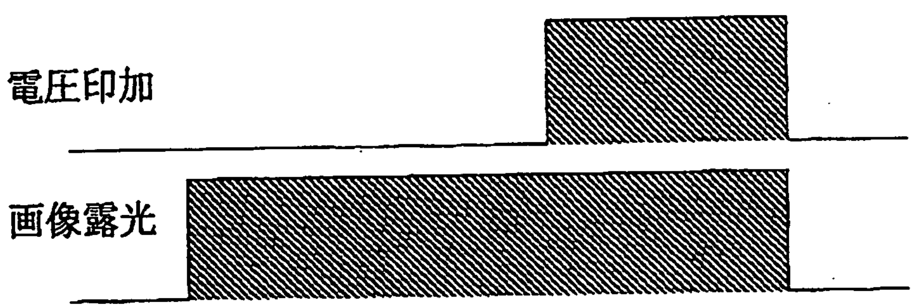


240
220
200
180
160
140
120
○ 1/400
□ 1/125
＋ 1/60
× 1/4
△ 2. 0 sec
画像読み取り信号
-2. 0
-1. 5
-1. 0
-0. 5
0
露光量 ΔH　log (lux・sec)

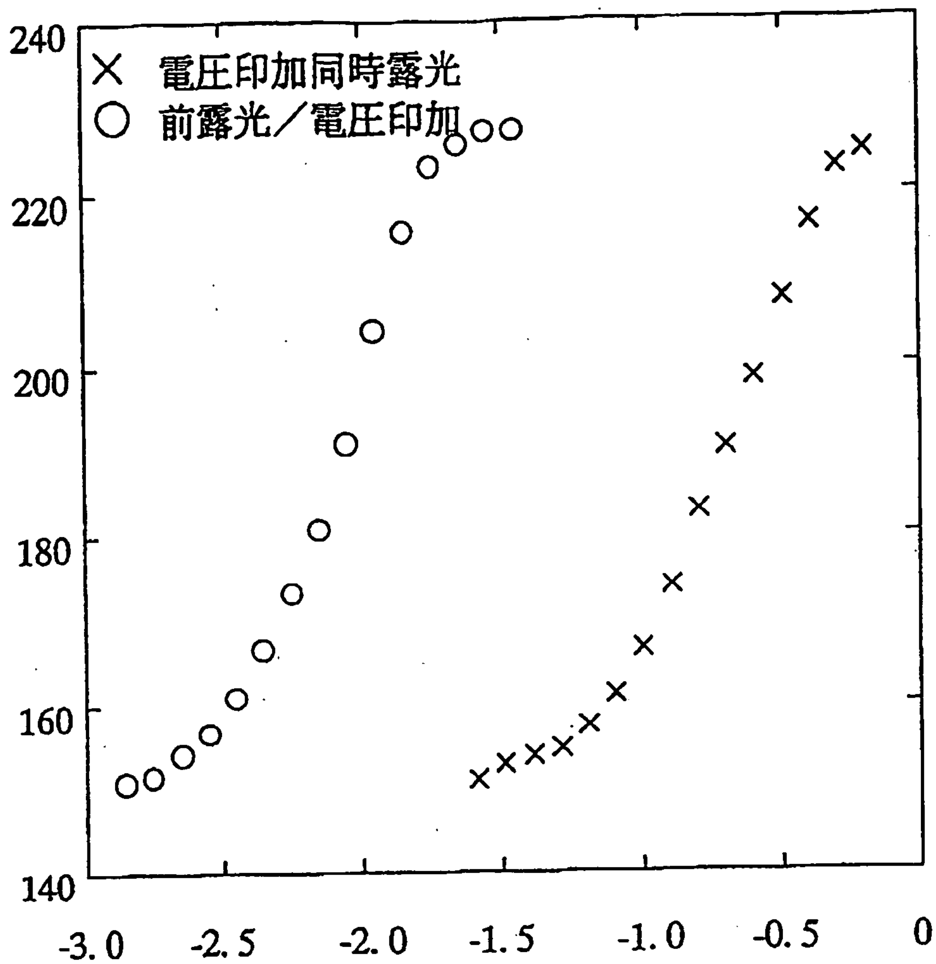
【図３１】



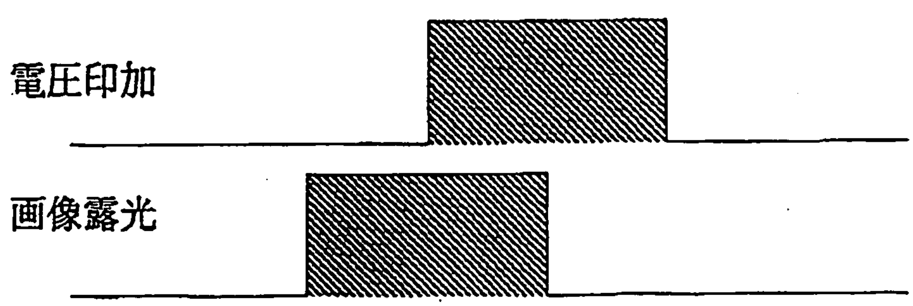
【図３２】



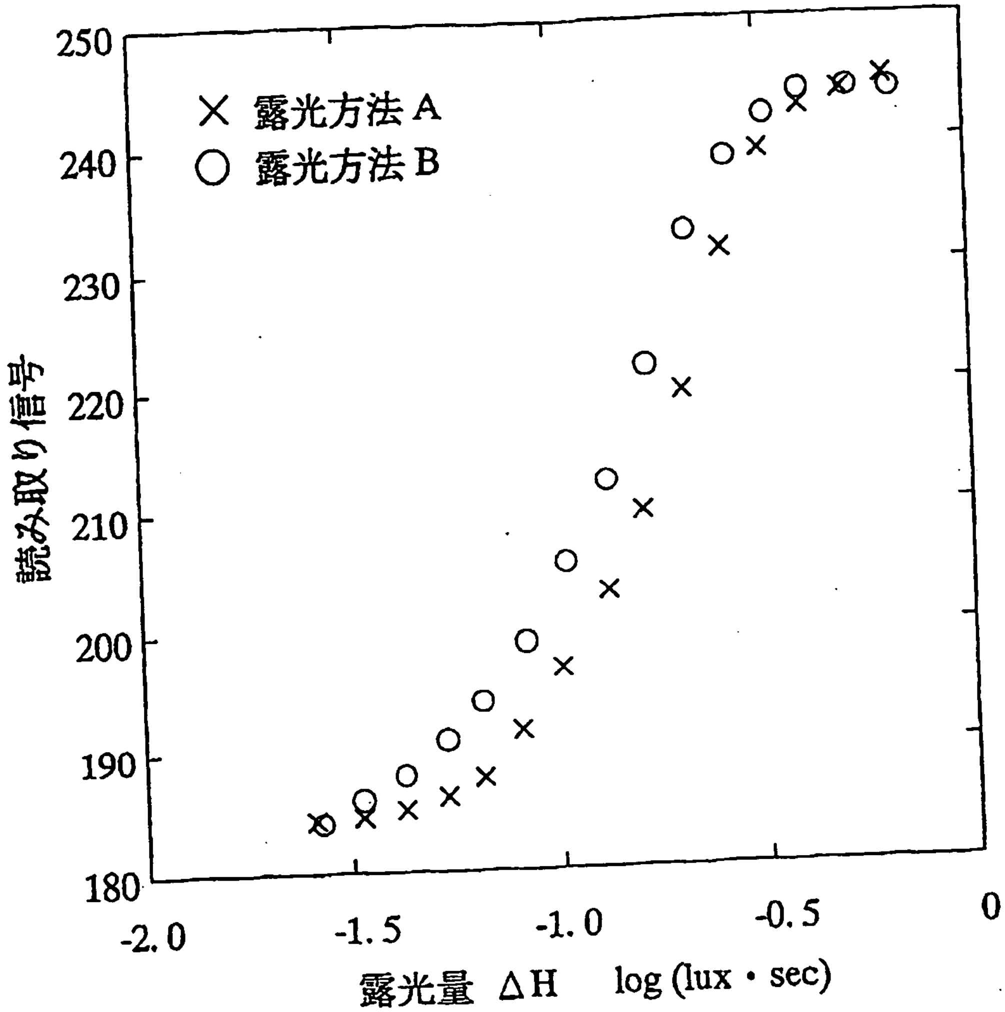
【図３３】


240
220
200
180
160
140
×　電圧印加同時露光
○　前露光／電圧印加
-3. 0
-2. 5
-2. 0
-1. 5
-1. 0
-0. 5
0

【図３４】


電圧印加
画像露光

【図３５】


250
240
230
220
210
200
190
180
× 露光方法Ａ
○ 露光方法Ｂ
読み取り信号
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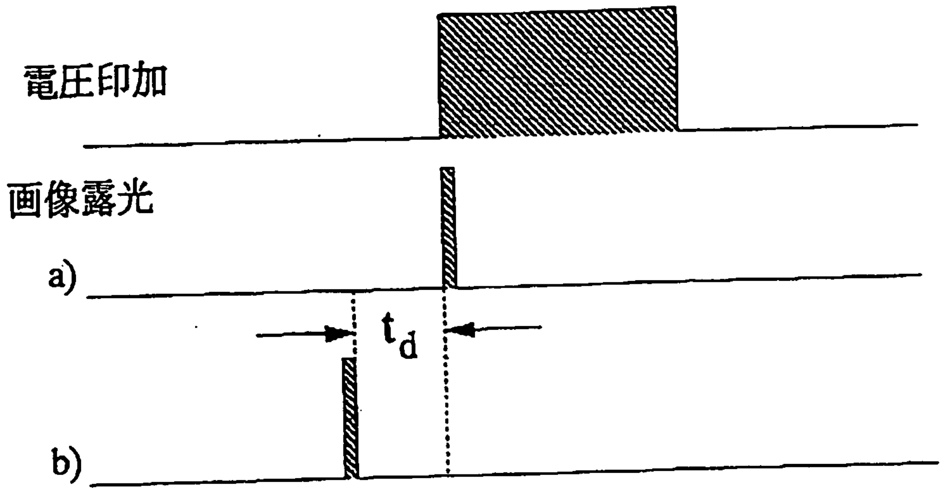
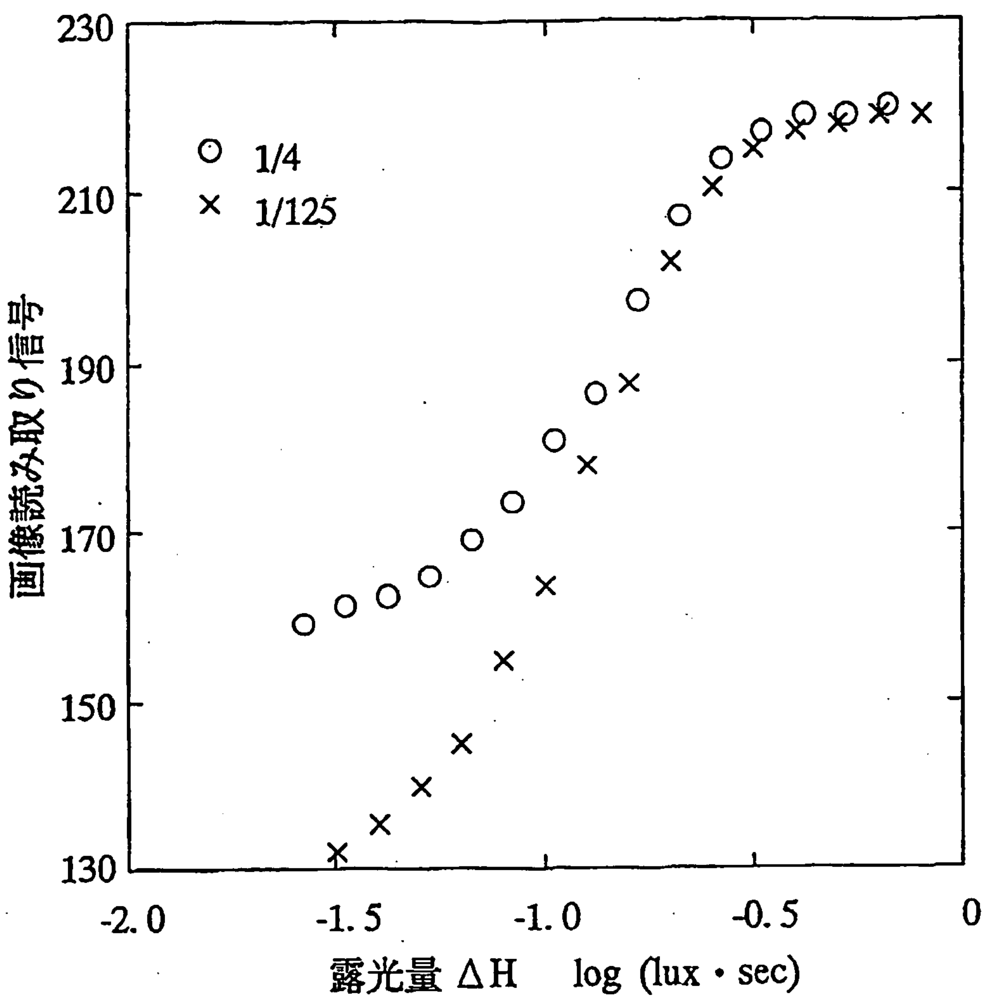
-1. 5
-1. 0
-0. 5
0
露光量　ΔH　log (lux・sec)

【図３６】



37】


230
210
190
170
150
130
画像読み取り信号
○ 1/4
× 1/125
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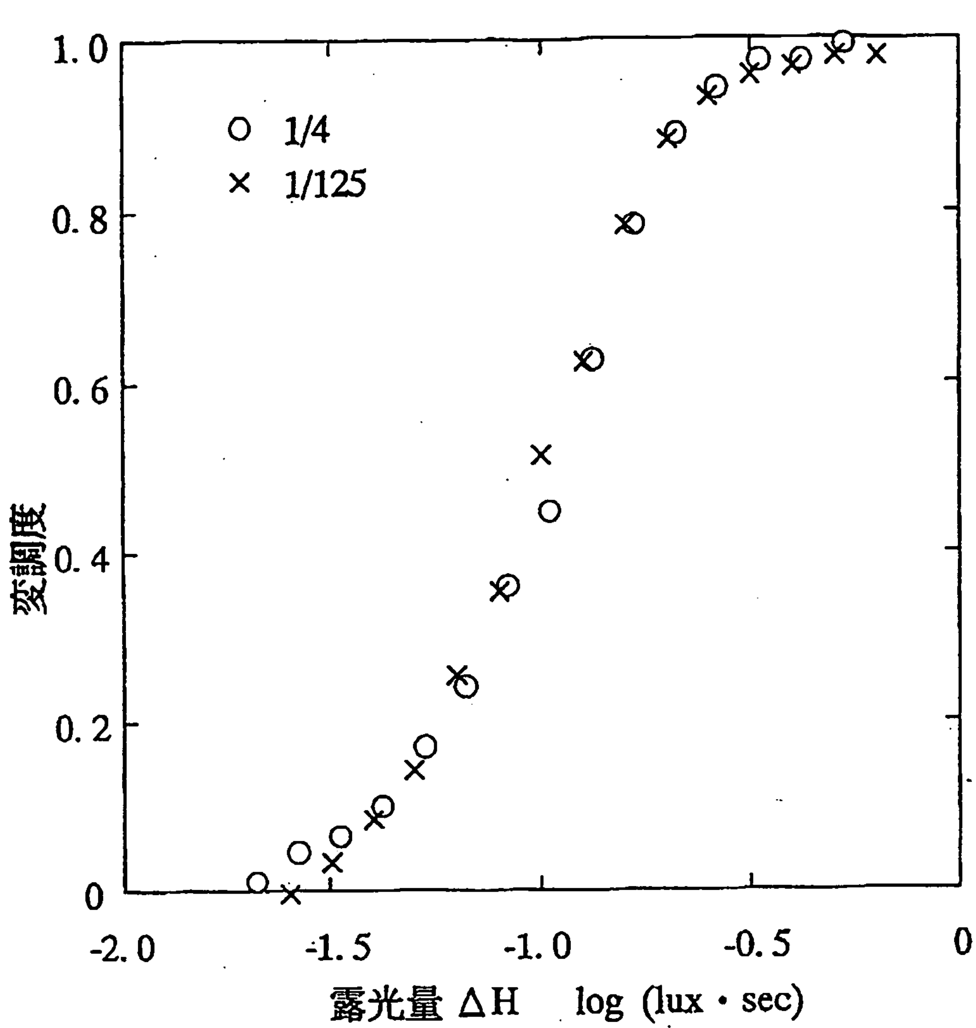
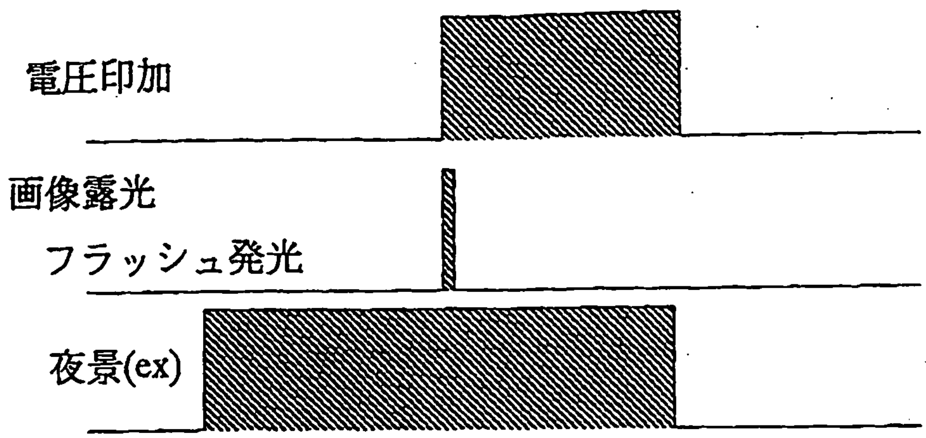
-0.5
0
露光量 ΔH　log (lux・sec)

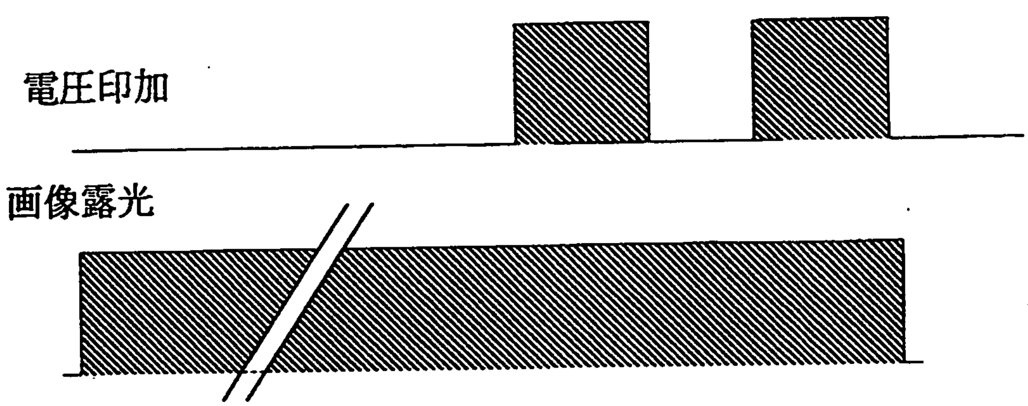
【図３８】



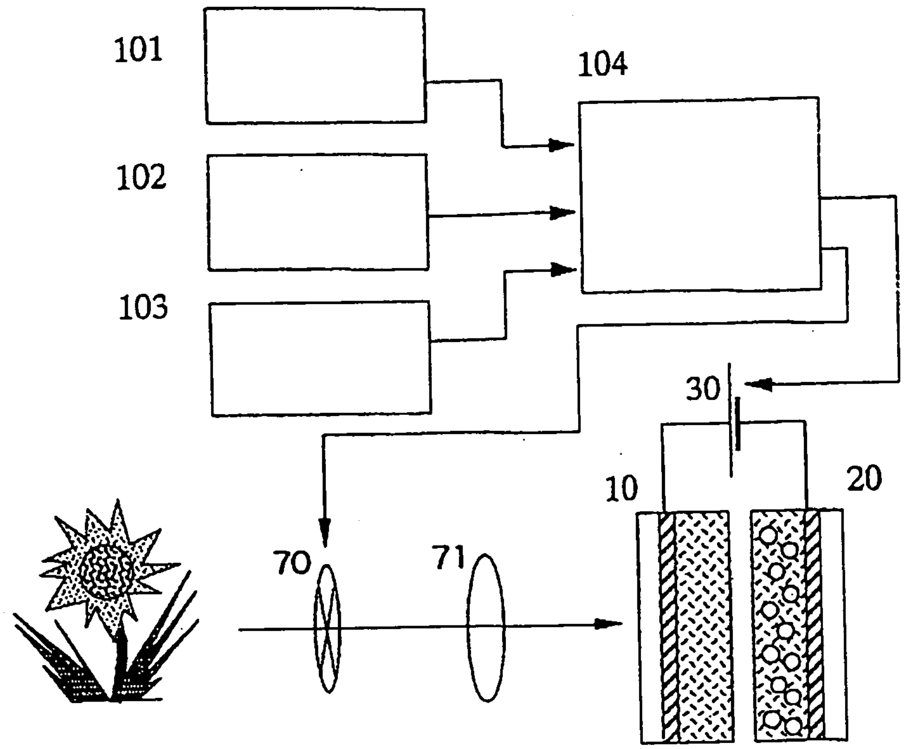
【図３９】



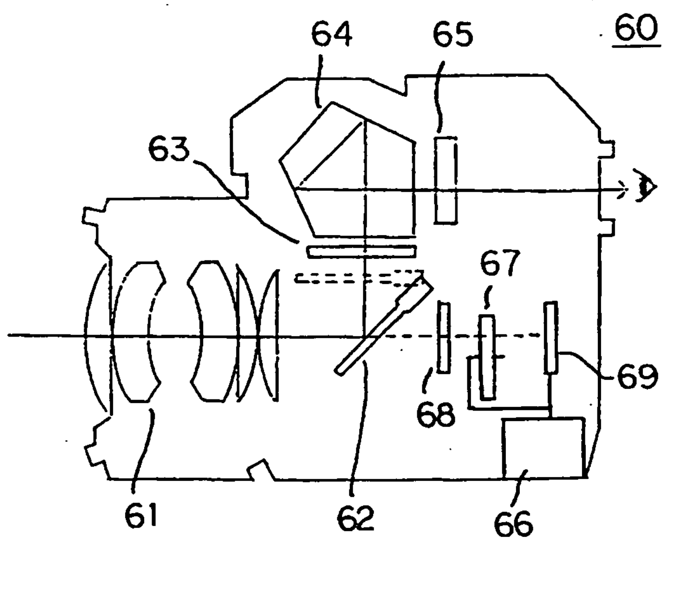
【図４０】



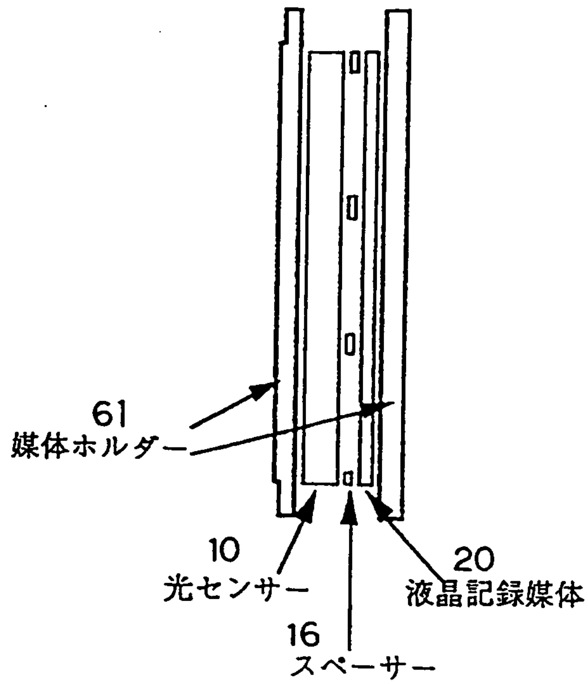
【図４１】



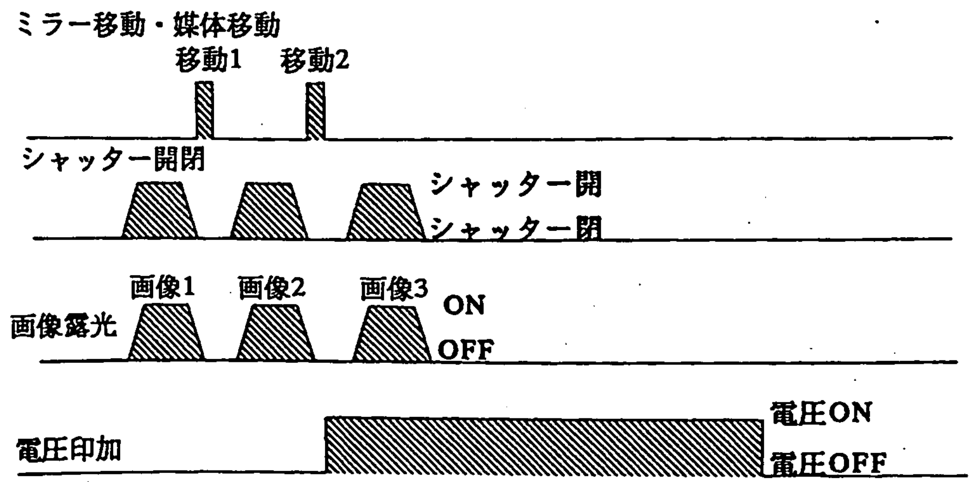
【図４２】



【図４３】

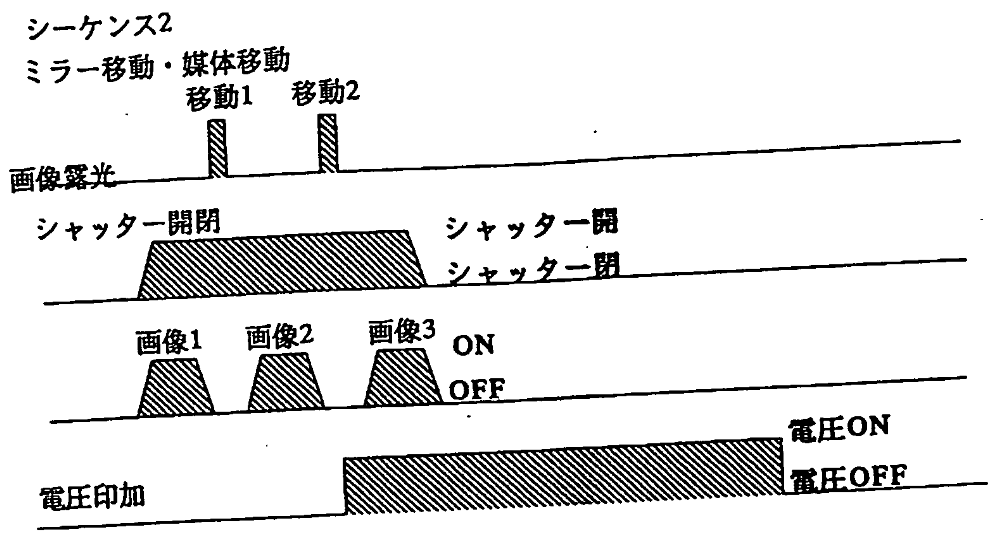


【図４４】
シーケンス1

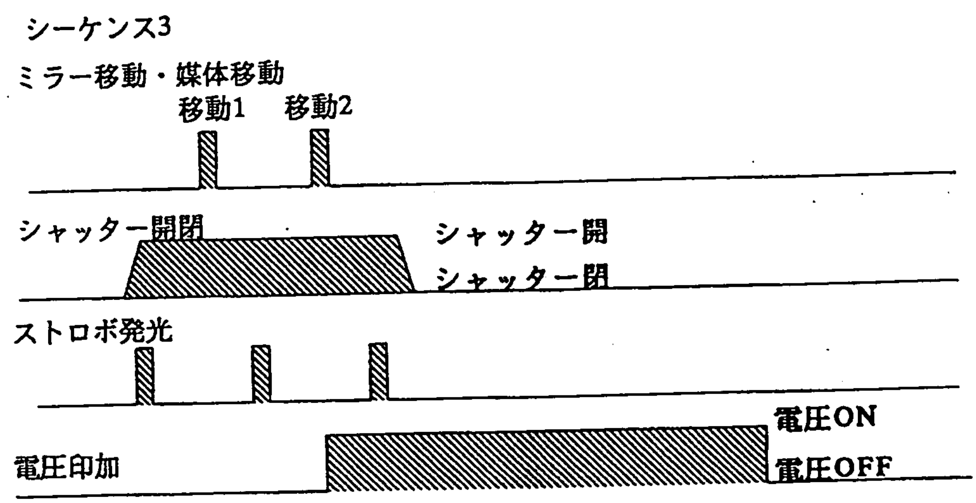


 出証特平０７－３０２７０５８

【図４５】


シーケンス2
ミラー移動・媒体移動
移動1
移動2
画像露光
シャッター開閉
シャッター開
シャッター閉
画像1
画像2
画像3
ON
OFF
電圧ON
電圧OFF
電圧印加

【図４６】


シーケンス3
ミラー移動・媒体移動
移動1
移動2
シャッター開閉
シャッター開
シャッター閉
ストロボ発光
電圧ON
電圧OFF
電圧印加

【書類名】　要約書

【要約】

【目的】　弱い光でもコントラストの大きな情報記録が可能な光センサを得る。

【構成】　電極上に光導電層を有し、情報記録媒体への情報形成に使用される光センサにおいて、光センサの電極と情報記録媒体の電極の間に、電圧を印加しない状態または逆極性の電圧を印加した状態で露光した後、光センサの電極と情報記録媒体の電極の間に電圧を印加、もしくは情報露光した状態で、電圧印加を停止し、または逆極性の電圧を印加した後、再びもとの電圧を印加することにより電圧を印加し続けた場合と導電性が等しくなる光センサによって液晶等の情報記録媒体に記録する。

【選択図】　図１６

出 願 人 履 歴 情 報

識別番号　　　　　〔000002897〕

1．変更年月日　　1990年　8月27日
　［変更理由］　新規登録
　　住　所　　東京都新宿区市谷加賀町一丁目1番1号
　　氏　名　　大日本印刷株式会社

B. D. DeKenzi

Case No. 2122-4028 Serial No. 08/428,325

Date Mailed October 29, 1999 ATTY BDD

Date Due in the Patent Office

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1.- 1. Japanese Priority Application Nos. 6-89489 and 7-91030;

2.- 2. Claim To Convention Priority;

3.- 3. Certificate of Mailing; and

4.- 4. Return Receipt Postcard.

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6.-

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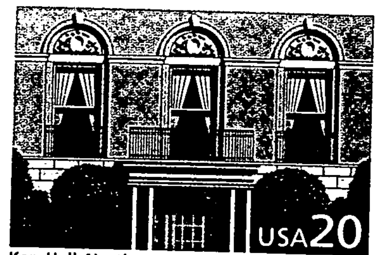
PATENT & TRADEMARK OFFICE

B. D. DeRenzi



Kerr Hall Northeastern University 1898-1998

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DOCKET DEPT.

1999 NOV -4 P 3:45

MORGAN & FINNEGAN LLP

MORGAN & FINNEGAN, L.L.P.
345 PARK AVENUE
NEW YORK, NEW YORK 10154-0053

Case No. 2122-4028 Serial No. ~~08/428,325~~

Date Mailed October 29, 1999 ATTY BDD

Date Due in the Patent Office ______________

The return of this post card, properly stamped, will acknow[illegible] Office of t[illegible]

1.- 1. Japanese Priority Application Nos. 6-89489 and 7-91030;

2.- 2. Claim To Convention Priority;

3.- 3. Certificate of Mailing; and

4.- 4. Return Receipt Postcard.

5.-

6.-

PATENT

Docket No. 2122-4028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT(S):	Masato Okabe		
SERIAL NO.:	08/428,325	**GROUP ART UNIT:**	2871
FILED:	April 25, 1995	**EXAMINER:**	W. Malinowski
FOR:	PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD, AND INFORMATION RECORDING SYSTEM		

CERTIFICATE OF MAILING (37 C.F.R. 1.8a)

ASSISTANT COMMISSIONER FOR PATENTS
Washington, D.C. 20231

Sir:

I hereby certify that the attached Japanese Priority Application Nos. 6-89489 and 7-91030; Claim To Convention Priority; and Postcard, along with any paper(s) referred to as being attached or enclosed and this Certificate of Mailing are being deposited with the United States Postal Service on date shown below with sufficient postage as first-class mail in an envelope addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

Respectfully submitted,

MORGAN & FINNEGAN, L.L.P.

Dated: October 29, 1999

Bruce D. DeRenzi

Bruce D. DeRenzi

CORRESPONDENCE ADDRESS:
MORGAN & FINNEGAN LLP
345 Park Avenue
New York, New York 10154
(212) 758-4800
(212) 751-6849 Facsimile

FORM: CERT..NY
Rev. 05/27/98

CORRESPONDENCE #10

PATENT Docket No. 2122-4028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	:	Masato Okabe	Group Art Unit: 2871
Serial No.	:	08/428,325	Examiner: W. Malinowski
Filed	:	April 25, 1995	
For	:	**PHOTOELECTRIC SENSOR, INFORMATION RECORDING SYSTEM AND INFORMATION RECORDING AND REPRODUCING METHOD**	

AMENDMENT

ASSISTANT COMMISSIONER OF PATENTS
Washington, D.C. 20231

Sir:

The present amendment is filed in response to the Office Action dated September 15, 1999. A petition and fee for a three month extension for filing this amendment is submitted concurrently herewith.

In The Specification

Please amend the Abstract to read as follows:

--ABSTRACT

The present invention relates to an information recording system comprising an information recording medium and a photoelectric sensor capable of recording light information on the information recording medium in the form of visible information or electrostatic

information, and to an information recording method wherein light information is recorded on an information recording medium utilizing an photoelectric sensor.--

In The Claims

Please cancel claims 1-3, 10-12 and 16-18 without prejudice or disclaimer. Please amend claims 4, 8, 13, 14 and 15 as follows:

4. (amended) An [image] information recording method wherein light information is recorded on an information recording medium by exposure to light information, characterized by the use of [the] a photoelectric sensor having a photoconductive layer on an electrode [as claimed in Claim 1 or 3] and an information recording medium having an information recording layer formed on an electrode,

the electrode of at least one of said photoelectric sensor and said information recording medium being a transparent electrode, and

said photoelectric sensor being opposed to said information recording medium on the optical axis with a gap located therebetween, or said photoelectric sensor and said information recording medium being stacked on each other optionally with [or without] a dielectric interlayer located therebetween,

wherein when voltage is applied to said photoelectric sensor after said photoelectric sensor has been exposed to light with no voltage applied thereto or voltage of opposite polarity applied thereto, a photo-induced current is generated depending on exposure quantity so that the information can be recorded on said information recording medium,

so that after said photoelectric sensor has been exposed to light information or while said photoelectric sensor is being exposed to light information, the application of voltage between both said electrodes is started.

8. (amended) An [image] information recording method wherein light information is recorded on an information recording medium by exposure to information light, characterized by the use of a photoelectric sensor having a photoconductive layer on an electrode [as claimed in Claim 2 or 3] and an information recording medium including an information recording layer formed on an electrode,

the electrode of at least one of said photoelectric sensor and said information recording medium being a transparent electrode, and

said photoelectric sensor being opposed to said information recording medium on the optical axis with a gap located therebetween, or said photoelectric sensor and said information recording medium being stacked upon each other optionally with [or without] a dielectric interlayer located therebetween,

wherein said photoelectric sensor is exposed to information light with voltage applied thereto, whereby the exposed portion is made higher in conductivity than the unexposed portion, and the exposed portion is kept still higher in conductivity than the unexposed portion even after the exposure of said photoelectric sensor to information light has been finished, and while said photoelectric sensor remains exposed to information light or after the exposure of said photoelectric sensor to information light has been finished, the application of voltage thereto is interrupted or voltage of opposite polarity is applied thereto, whereby the resulting conductivity

is made equal to that obtained by the continued application of voltage,

so that said photoelectric sensor is exposed to light information, and while said photoelectric sensor is being exposed to light information or after said sensor has been exposed to light information, the period of time wherein no voltage is applied to both said electrodes or the period of time wherein voltage of opposite polarity is applied to both said electrodes is provided.

13. (amended) [The] An information recording method [as claimed in Claim 11], wherein light information is recorded on an information recording medium by exposure to light information, wherein the photoelectric sensor of Claim 4 or 19 having a photoconductive layer on an electrode and an information recording medium having an information recording layer formed on an electrode are used,

the electrode of at least one of said photoelectric sensor and said information recording medium being a transparent electrode, and

said photoelectric sensor being opposed to said information recording medium on the optical axis with a gap located therebetween, or said photoelectric sensor and said information recording medium being stacked on each other optionally with a dielectric interlayer located therebetween,

so that said photoelectric sensor is exposed to light information and voltage is applied between both electrodes of said photoelectric sensor and said recording medium to record information thereon, characterized in that the exposure of said sensor image to light and the application of voltage to both said electrodes are properly achieved in response to shutter

speed, so that the reciprocity law can be satisfied over a wide range, [characterized in] such that a reciprocity law failure is compensated for by starting the exposure of the photoelectric sensor [as claimed in Claim 1 or 3] to image light prior to starting the application of voltage to both said electrodes.

14. (Amended) [The] An information recording method as [claimed in Claim 11], wherein light information is recorded on an information recording medium by exposure to light information, wherein the photoelectric sensor of Claim 4 or 19 having a photoconductive layer on an electrode and an information recording medium having an information recording layer formed on an electrode are used,

the electrode of at least one of said photoelectric sensor and said information recording medium being a transparent electrode, and

said photoelectric sensor being opposed to said information recording medium on the optical axis with a gap located therebetween, or said photoelectric sensor and said information recording medium being stacked on each other optionally with a dielectric interlayer located therebetween,

so that said photoelectric sensor is exposed to light information and voltage is applied between both electrodes of said photoelectric sensor and said recording medium to record information thereon, characterized in that the exposure of said sensor to image light and the application of voltage to both said electrodes are properly achieved in response to shutter speed, so that the reciprocity law can be satisfied over a wide range, [characterized in] such that the period of time wherein no voltage is applied to both said electrodes or the period of time

wherein voltage of opposite polarity is applied to both said electrodes is provided while the photoelectric sensor [claimed in Claim 2 or 3] is being exposed to image light or after the exposure of said sensor to image light has been finished, thereby compensating for a reciprocity law failure.

15. (Amended) [The] An information recording method [as claimed in Claim 11], wherein light information is recorded on an information recording medium by exposure to light information, wherein the photoelectric sensor of Claim 4 or 19 having a photoconductive layer on an electrode and an information recording medium having an information recording layer formed on an electrode are used,

the electrode of at least one of said photoelectric sensor and said information recording medium being a transparent electrode, and

said photoelectric sensor being opposed to said information recording medium on the optical axis with a gap located therebetween, or said photoelectric sensor and said information recording medium being stacked on each other optionally with a dielectric interlayer located therebetween,

so that said photoelectric sensor is exposed to light information and voltage is applied between both electrodes of said photoelectric sensor and said recording medium to record information thereon, characterized in that the exposure of said sensor to image light and the application of voltage to both said electrodes are properly achieved in response to shutter speed, so that the reciprocity law can be satisfied over a wide range, [characterized in] such that the application of voltage to both said electrodes is started after an elapse of a certain time upon

the exposure of the photoelectric sensor [as claimed in Claim 1 or 3] to image light finished.

Please add new claims 19-28 as follows:

19. (New) An information recording method wherein light information is recorded on an information recording medium by exposure to light information, characterized by the use of a photoelectric sensor having a photoconductive layer on an electrode and an information recording medium having an information recording layer formed on an electrode,

the electrode of at least one of said photoelectric sensor and said information recording medium being a transparent electrode, and

said photoelectric sensor being opposed to said information recording medium on the optical axis with a gap located therebetween, or said photoelectric sensor and said information recording medium being stacked on each other optionally with a dielectric interlayer located therebetween,

wherein said photoelectric sensor is exposed to information light with voltage applied thereto, whereby the exposed portion is made higher in conductivity than the unexposed portion, and the exposed portion is kept still higher in conductivity than the unexposed portion even after the exposure of said photoelectric sensor to information light has been finished, and while said photoelectric sensor remains exposed to information light or after the exposure of said photoelectric sensor to information light has been finished, the application of voltage thereto is interrupted or voltage of opposite polarity is applied thereto, whereby the resulting conductivity is made equal to that obtained by the continued application of voltage,

so that after said photoelectric sensor has been exposed to light information or

while said photoelectric sensor is being exposed to light information, the application of voltage between both said electrodes is started.

20. (New) The information recording method as claimed in Claim 4 or 19, wherein the photoelectric sensor is characterized in that when an electric field of 10^5 to 10^6 V/m is applied to said photoelectric sensor, a current passing through the unexposed portion has a current density of 10^{-4} to 10^{-7} A/cm^2.

21. (New) The information recording method as claimed in Claim 19, characterized in that said information recording medium is a liquid crystal recording medium including on said electrode a liquid crystal-polymer composite material layer comprising liquid crystals and resin.

22. (New) The information recording method as claimed in Claim 21, characterized in that after an elapse of a certain time upon the exposure of said photoelectric sensor to light information finished, the application of voltage to both said electrodes is started thereby making the latitude of the recorded image wide.

23. (New) The information recording method as claimed in Claim 22, characterized in that the period of time from the finish of the exposure of said photoelectric sensor to light information to the start of the application of voltage to both said electrodes is 0 to 500 milliseconds.

24. (New) The information recording method as claimed in Claim 8, wherein the photoelectric sensor is characterized in that when an electric field of 10^5 to 10^6 V/m is applied to said photoelectric sensor, a current passing through the unexposed portion has a current density of 10^{-4} to 10^{-7} A/cm^2.

25. (New) The information recording method as claimed in Claim 24, characterized in that said information recording medium is a liquid crystal recording medium including on said electrode a liquid crystal-polymer composite material layer comprising liquid crystals and resin.

26. (New) The information recording method as claimed in Claim 13, characterized in that said information recording medium is a liquid crystal recording medium including on said electrode a liquid crystal-polymer composite material layer comprising liquid crystals and resin.

27. (New) The information recording method as claimed in Claim 14, characterized in that said information recording medium is a liquid crystal recording medium including on said electrode a liquid crystal-polymer composite material layer comprising liquid crystals and resin.

28. (New) The information recording method as claimed in Claim 15, characterized in that said information recording medium is a liquid crystal recording medium

including on said electrode a liquid crystal-polymer composite material layer comprising liquid crystals and resin.

REMARKS

Reconsideration of the present application as amended is respectfully requested. Claims 1-18 are pending as of the filing of this Amendment.

1. Priority

The Examiner noted in the Office Action that, while applicant had made a claim for foreign priority based on applications filed in Japan on 27 April 1994 and 17 April 1995, applicant had not yet filed a certified copy of the Japanese applications as required by 35 U.S.C. §119(b). Applicant respectfully submits that, on October 29, 1999, a Claim For Convention Priority was filed by which duly certified copies of the Japanese applications were submitted.

2. Drawings

The drawings were objected to as failing to comply with 37 C.F.R. 1.84(p)(5) because the reference to part number "63" in Figure 42 is not identified in the specification. Applicant will correct Figure 42 and/or the amend the specification to obviate this objection upon formal allowance of the pending claims.

3. Specification

The Examiner objected to the abstract of the disclosure because it is more than one paragraph and should not exceed 260 words in length. Applicant has amended the abstract herein to obviate this objection.

4. Claim Objections

The Examiner has objected to claims 4-9 and 13-15 under 37 C.F.R. 1.75 as being in improper form because a multiple dependent claim may not depend from another multiple dependent claim. These claims have been amended herein to obviate this objection.

5. Claim Rejections

The Examiner rejected claims 1-2, 10-12 and 16-18 under 35 U.S.C. § 103(a) as being unpatentable over Takanashi et al. U.S. Patent No. 5,315,410. The Examiner rejected claim 3 under 35 U.S.C. §103(a) as being unpatentable over Takanashi in view of Ando et al. U.S. Patent No. 4,692,779 and Shimizu et al. U.S. Patent No. 5,646,927.

Applicant has cancelled claims 1-3, 10-12 and 16-18 herein without prejudice or disclaimer towards filing a continuing application. Claims 4, 8, 13, 14 and 15 have been amended herein as follows: claim 4 incorporates the limitations of claim 1 from which it depended; claim 8 incorporates the limitations of claim 2 from which it depended; and each of claims 13, 14, and 15 incorporate the limitations of claim 10 from which they depended. New claims 19 through 28 have been added to capture the remaining claim dependency associated with claims 1, 2 and 10. Remaining claims 5-9 have not been amended. All claims are believed

to be in condition for allowance.

CONCLUSION

Applicant respectfully submits that each of Claims 4-9, 13-15 and 19-28 herein is patentable. Early and favorable consideration is respectfully requested.

Respectfully submitted,

MORGAN & FINNEGAN, L.L.P.

Date: March 15, 2000

By: Bruce D. DeRenzi

Bruce D. DeRenzi
Reg. No. 33,676

Mailing Address:

MORGAN & FINNEGAN, L.L.P.
345 Park Avenue
New York, New York 10154
(212) 758-4800 Telephone
(212) 758-6849 Facsimile

PATENT

Docket No. 2122-4028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s)	:	Masato Okabe	
Serial No.	:	08/428,325	Group Art Unit: 2871
Filed	:	April 25, 1995	Examiner: W. Malinowski
For	:	**PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD AND INFORMATION RECORDING SYSTEM**	

AMENDMENT FEE TRANSMITTAL

ASSISTANT COMMISSIONER FOR PATENTS
Washington, D.C. 20231

Sir:

Transmitted herewith is an Amendment for the above-identified application.

[ ] No additional fee is required.

[X] The additional fee has been calculated as shown below:

CLAIMS AS AMENDED

	Claims Remaining After Amendment		Highest No. Covered by Previous Payments	Present Extra	Rate	Additional Fee
Total* Claims	23	-	20	= 3	x $18.00	$ 54.00
Independent Claims	3	-	5	= 0	x $78.00	$ 0.00
Multiple Dependent Claim(s)	(If claims added by amendment include Multiple Dependent Claim(s) and there was not Multiple Dependent Claims(s) in application before amendment add $260.00 to additional fee.)					$ 260.00
					Total:	$ 314.00

[ ] Statement of "Small Entity" Status Under 37 CFR § 1.27 filed __________.
Reduced Fees Under 37 CFR § 1.9(f) (50% of total) paid herewith. $ ______.

---

* Includes all independent and single dependent claims and all claims referred to in multiple dependent claims. See 37 C.F.R. § 1.75(c).

Docket No. 2122-4028

[ ] Charge fee to Deposit Account No. 13-4500. Order No. __________________.
A DUPLICATE COPY OF THIS SHEET IS ATTACHED.

[X] The Assistant Commissioner is hereby authorized to charge any additional fees which may be required for this amendment, including all fees pursuant to 37 C.F.R. § 1.17 for its timely consideration, or credit any overpayment to Deposit Account No. 13-4500. Order No. 2122-4028. A DUPLICATE COPY OF THIS SHEET IS ATTACHED.

[ ] ____ Page(s) of substitute Sequence Listing

[ ] ____ Computer disk(s) containing substitute Sequence Listing

[ ] Statement under 37 C.F.R. § 1.825(b) that the computer and paper copies of the substitute Sequence Listing are the same.

[X] A check in the amount of $ 314.00 to cover the filing fee is attached.

Respectfully submitted,

MORGAN & FINNEGAN, L.L.P.

Dated: March 15, 2000

By: Bruce D. DeRenzi
Bruce D. DeRenzi
Reg. No. 33,676

CORRESPONDENCE ADDRESS:

MORGAN & FINNEGAN, L.L.P.
345 Park Avenue
New York, New York 10154
(212) 758-4800
(212) 751-6849 Facsimile

FORM: AMD-TRAN.NY
Rev. 11/13/98

PATENT

Docket No. 2122-4028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	:	Masato Okabe	Group Art unit : 2871
Serial No.	:	08/428, 325	Examiner : W. Malinowski
Filed	:	April 25, 1995	
For	:	**PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD, AND INFORMATION RECORDING SYSTEM**	

PETITION AND FEE FOR EXTENSION OF TIME (37 C.F.R. §1.136(a))

ASSISTANT COMMISSIONER FOR PATENTS
Washington, D.C. 20231

Sir:

1. This is a petition for an extension of time for filing an Amendment.

2. The communication in connection with the matter for which this extension is requested

   [X] is filed herewith.

   [ ] has been filed on ______________________________.

3. [ ] Applicant(s) is/are entitled to Small Entity Status. [ ] Small Entity Statement is attached. [ ] Statement has already been filed.

4.

		Total Months Requested	Fee for Other than Small Entity	Fee for Small Entity
a.	[ ]	one month	$110.00	$55.00
b.	[ ]	two months	$380.00	$190.00
c.	[X]	three months	$870.00	$435.00
d.	[ ]	four months	$1,360.00	$680.00
e.	[ ]	five months	$1,850.00	$925.00

f. [ ] An extension for __________ months has already been secured for filing the above-identified communication and the fee paid therefor of $ ___________ is deducted from the total fee due for the total months of extension now requested. The fee for this extension ($ ________), minus the fee previously paid ($ __________) equals $ ___________ (total fee due).

Docket No. 2122-4028

5. [X] A check in the amount of $ 870.00 to cover the extension fee is attached.

6. [ ] Charge fee to Deposit Account No. 13-4500. Order No. ___________. A DUPLICATE COPY OF THIS SHEET IS ATTACHED.

7. [X] The Assistant Commissioner is hereby authorized to charge any additional fees which may be required by this paper, or credit any overpayment to Deposit Account No. 13-4500. Order No. 2122-4028. A DUPLICATE COPY OF THIS SHEET IS ATTACHED.

Respectfully submitted,

MORGAN & FINNEGAN, L.L.P.

Dated: March 15, 2000

By: Bruce D. DeRenzi
Bruce D. DeRenzi

Registration No. 33,676

CORRESPONDENCE ADDRESS:

MORGAN & FINNEGAN, L.L.P.
345 Park Avenue
New York, New York 10154
(212) 758-4800
(212) 751-6849 Facsimile

FORM: PET-XOT.NY
Rev. 11/13/98

527716_1

Security enhanced document. See back for details.

18570

MORGAN & FINNEGAN, L.L.P.
ATTORNEYS AT LAW
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MP

[redacted]

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Case No. 2122-4028 Serial No. 08/428,325

Date Mailed March 15, 2000 ATTY BDD

Date Due in the Patent Office March 15, 2000

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2. Amendment Fee Transmittal (in duplicate);

2.- 3. Petition And Fee For Extension Of Time

3.- (37 C.F.R. §1.136(a)) (in duplicate);

4.- 4. Checks in the amount of $870.00 and $314.00;

5. Certificate of Mailing; and

5.- 6. Postcard

6.-

B. D. DeRenzi

Case No. 2122-4028 Serial No. 08/428,325

Date Mailed March 15, 2000 ATTY BDD

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MORGAN & FINNEGAN, L.L.P.

345 PARK AVENUE

NEW YORK, NEW YORK 10154-0053

PATENT

Docket No. 2122-4028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT(S):	Masato Okabe		
SERIAL NO.:	08/428,325	**GROUP ART UNIT:**	2871
FILED:	April 25, 1995	**EXAMINER:**	W. Malinowski
FOR:	PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD, AND INFORMATION RECORDING SYSTEM		

CERTIFICATE OF MAILING (37 C.F.R. 1.8a)

ASSISTANT COMMISSIONER FOR PATENTS
Washington, D.C. 20231

Sir:

I hereby certify that the attached Amendment; Amendment Fee Transmittal (in duplicate); Petition And Fee For Extension Of Time (37 C.F.R. §1.136(a)) (in duplicate); Checks in the amount of $870.00 and $314.00; and Postcard, along with any paper(s) referred to as being attached or enclosed and this Certificate of Mailing are being deposited with the United States Postal Service on date shown below with sufficient postage as first-class mail in an envelope addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

Respectfully submitted,

MORGAN & FINNEGAN, L.L.P.

Dated: March 15, 2000

Bruce D. DeRenzi
Bruce D. DeRenzi

CORRESPONDENCE ADDRESS:
MORGAN & FINNEGAN LLP
345 Park Avenue
New York, New York 10154
(212) 758-4800
(212) 751-6849 Facsimile

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR		ATTORNEY DOCKET NO.
08/428,325	04/25/95	OKABE	M	2122-4028

MMC1/0627

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NEW YORK NY 10154

EXAMINER	
MALINOWSKI,W	
ART UNIT	PAPER NUMBER
2871	

DATE MAILED: 06/27/00

FINAL REJECTION

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CASE 2122-4028 ATTY BDD
DUE DATE September 27, 2000
STATUTORY DATE December 27, 2000
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Office Action Summary	Application No. 08/428,325	Applicant(s) Okabe
	Examiner Walter Malinowski	Group Art Unit 2871

[X] Responsive to communication(s) filed on *Apr 6, 2000*

[X] This action is **FINAL.**

[ ] Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle* 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire *3* month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claim

[X] Claim(s) *4-9, 13-15, and 19-28* is/are pending in the applicat

Of the above, claim(s) ______ is/are withdrawn from consideration

[ ] Claim(s) ______ is/are allowed.

[X] Claim(s) *4-9, 13-15, and 19-28* is/are rejected.

[ ] Claim(s) ______ is/are objected to.

[ ] Claims ______ are subject to restriction or election requirement.

Application Papers

[ ] See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

[ ] The drawing(s) filed on ______ is/are objected to by the Examiner.

[ ] The proposed drawing correction, filed on ______ is [ ] approved [ ] disapproved.

[ ] The specification is objected to by the Examiner.

[ ] The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

[X] Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

[X] All [ ] Some* [ ] None of the CERTIFIED copies of the priority documents have been

[X] received.

[ ] received in Application No. (Series Code/Serial Number) ______ .

[ ] received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: ______

[ ] Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

[ ] Notice of References Cited, PTO-892

[ ] Information Disclosure Statement(s), PTO-1449, Paper No(s). ______

[ ] Interview Summary, PTO-413

[ ] Notice of Draftsperson's Patent Drawing Review, PTO-948

[ ] Notice of Informal Patent Application, PTO-152

— SEE OFFICE ACTION ON THE FOLLOWING PAGES —

DETAILED ACTION

Drawings

1. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference sign(s) not mentioned in the description: part number "63" of Fig. 42 is not identified in the specification. Correction is required.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 4-9, 13-15, and 19-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Takanshi et al. (Takanashi), U.S. Patent No. 5,315,410.

Takanashi discloses a photoelectric sensor including a photoconductive layer on an electrode and used to record information on an information recording medium (column 5, lines 50-60), characterized in that when voltage is applied to the sensor after the sensor has been exposed to light with no voltage applied thereto (as shown in Figs. 3-8; column 7, lines 39-68) or voltage of opposite polarity applied thereto.

Takanashi does not disclose a photo-induced current is generated depending upon exposure quantity so that the information can be recorded on the information recording medium.

Because Takanashi discloses an electric field is applied (column 7, lines 27-30) and light is provided to the photosensitive layer (column 6, line 37), photo-induced currents are generated.

Therefore, it would have been obvious a photo-induced current is generated depending upon exposure quantity so that the information can be recorded on the information recording medium in the device of Takanashi.

Furthermore, Takanashi does not disclose the exposed portion is made higher in conductivity than the unexposed portion and the exposed portion is kept still higher in conductivity than the unexposed portion even after the exposure of the sensor to information light has been finished, and while the sensor remains exposed to information light or after the exposure of the sensor to information light has been finished, nor the application of voltage of opposite polarity is applied thereto, and then the original voltage is again applied thereto, whereby the resulting conductivity is made equal to that obtained by the continued application of voltage.

Takanashi does disclose the impedance of the photoconductive layer 114 varies in accordance with the optical image of the object O, so that the electric field applied to the photo-modulation layer 111 depends on the optical image of object O and the application of the image-dependent electric field to the photo-modulation layer 111 forms a charge latent image on the photo-modulation layer 111 (column 12, lines 21-28). Takanashi also discloses that applied voltage time and amplitude may be varied (column 14, lines 15-25).

It would have been obvious to make the exposed portion higher in conductivity than the unexposed portion and keep the exposed portion still higher in conductivity than the unexposed portion even after the exposure of the sensor to information light has been finished so that the charge is reliably set in the recording medium.

Furthermore, it is well known to make the sensor exposed to information light or after the exposure of the sensor to information light has been finished, apply voltage of opposite polarity is applied thereto, and then the original voltage is again applied thereto, whereby the resulting conductivity is made equal to that obtained by the continued application of voltage to permit optimization of device performance.

Takanashi shows the image recording medium and the photoelectric sensor separated by an air gap (see Fig. 9). Since Takanashi teaches varying the applied voltage, it would have been obvious to optimize performance to comply with the reciprocity law.

Furthermore, Takanashi (see Fig. 10) shows the photoelectric sensor and the information recording medium being stacked on each other. Takanashi shows a mechanism 4 for starting the application of voltage to the electrodes.

Takanashi teaches the information recording medium is a liquid crystal recording medium including on the electrode a liquid crystal-polymer composite material layer comprising liquid crystals and resin (column 6, lines 1-5).

Since shutter speed and recording properties may be varied, it would have been obvious to satisfy the reciprocity law in optimizing performance.

Takanashi teaches the voltage applied is controlled.

4. Claims 20, 24, and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Takanshi et al. (Takanashi), U.S. Patent No. 5,315,410, as applied to Claims 4-9, 13-15, 19, 21-23, and 26-28 above, and further in view of Ando et al. (Ando), U.S. Patent No. 4,692,779, and Shimizu et al. (Shimizu), U.S. Patent No. 5,646,927.

Takanashi makes obvious the photoelectric sensor, but does not teach the photoelectric sensor is characterized in that when an electric field of 10^5 to 10^6 V/m is applied to the sensor, a current passing through the unexposed portion has a current density of 10^{-4} to 10^{-7} A/cm^2.

Ando teaches that liquid crystal in an image forming apparatus have electric fields on the order of 10^5 to 10^6 V/m applied (column 4, line 63, through column 5, line 2).

Shimizu teaches generated photocurrent is about 10^{-6} A/cm^2 (column 26, lines 1-8).

Therefore, as to Claim 3, it would have been obvious to use an electric field of 10^5 to 10^6 V/m and a current of 10^{-4} to 10^{-7} A/cm^2, as suggested by Ando and Shimizu, in the device of Takanashi.

Response to Arguments

5. Applicant's arguments filed March 20, 2000, have been fully considered but they are not persuasive.

No arguments were provided in the amendment.

Conclusion

6. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Walter Malinowski whose telephone number is (703) 308-3172.

wjm

June 26, 2000

WILLIAM L. SIKES
SUPERVISORY PATENT EXAMINER
GROUP 2800

CORRESPONDENCE #12

27123

PATENT TRADEMARK OFFICE

PATENT

Docket No. 2122-4028US1

Express Mail Label No. EF 099 148 680 US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

CONTINUED PROSECUTION APPLICATION (CPA) REQUEST TRANSMITTAL PURSUANT TO 37 C.F.R. § 1.53(d)

Named Inventor(s): Masato Okabe

Prior Application: 08/428,325
Examiner: W. Malinowski
Group Art Unit: 2871

COMMISSIONER FOR PATENTS AND TRADEMARKS
Box CPA
Washington, D.C. 20231

Sir:

1. This is a request for a [X] Continuation application [ ] Divisional application under 37 C.F.R. § 1.53(d) of prior application serial no. 08/428,325 filed on April 25, 1995 and entitled PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD AND INFORMATION RECORDING SYSTEM.

2. The following are enclosed herewith:

   [ ] Preliminary Amendment

   [ ] Information Disclosure Statement

   [ ] Copy of Reference Cited in Information Disclosure Statement

3. Please abandon the parent application at a time while the parent application is pending or at a time when the petition for extension of time in that application is granted and while this application is pending and has been granted a filing date, so as to make this application co-pending with said parent application. Please use all the contents of the parent application file wrapper, including the drawings, as the basic papers for the new application.

4. The fees to be charged are to be based on the number of claims:

   a. [ ] remaining after entering enclosed Amendment.

   b. [X] entered in the parent application as of the date of its abandonment.

   c. [ ] remaining after entering the Amendment After Final Rejection filed June 27, 2000 in the above-identified parent application.

CALCULATION OF APPLICATION

	Number		Number Extra	Rate for Non-Small Entity	Basic Fee $710.00
Total* Claims	19	-20=	0	x $18.00	$0.00
Independent Claims	3	- 3=	0	x $78.00	$0.00
Multiple Dependent Claims		[ ] yes Additional Fee =		$260.00	$0.00
		[x] no Additional Fee =		none	

Filing Fee Calculation $ 710.00

5. [ ] A statement claiming small entity status is attached or has been filed in the above-identified parent application and its benefit under 37 C.F.R. § 1.28(a) is hereby claimed. Reduced fees under 37 C.F.R. § 1.9(f) (50% of total) paid herewith $ ____________.

6. [X] A check in the amount of $ 710.00 in payment of the CPA application filing fees is attached.

7. [ ] Charge fee to Deposit Account No. 13-4500. Order No. __________________. A DUPLICATE COPY OF THIS SHEET IS ATTACHED.

8. [X] The Commissioner is hereby authorized to charge any additional fees which may be required for filing this application, including all extension of time fees pursuant to 37 C.F.R. § 1.17 for maintaining copendency with the parent application, or credit any overpayment to Deposit Account No. 13-4500. Order No. 2122-4028US1. A DUPLICATE COPY OF THIS DOCUMENT IS ATTACHED.

9. [X] Priority of application Serial No. 6-89489, filed on April 27, 1994 in Japan and priority of application Serial No. 7-91030, filed on April 17, 1995 in Japan is claimed under 35 U.S.C. § 119.

10. [X] The parent application is assigned of record to Dai Nippon Printing Co., Ltd. Recorded on August 24, 1995, Reel 7630, Frame 0063.

11. [ ] An assignment of the invention to ____ is attached along with the Assignment Recordation Form cover sheet.

12. [ ] A check in the amount of $40.00 for recording the Assignment is attached.

* Includes all independent and single dependent claims and all claims referred to in multiple dependent claims. See 37 C.F.R. § 1.75(c).

Docket No. 2122-4028US1
Express Mail Label No. EF 099 148 680 US

13. [X] The Power of Attorney was filed in the parent application.

14. [ ] A new Power of Attorney has been executed and is attached.

Respectfully submitted,

MORGAN & FINNEGAN, L.L.P.

Dated: December 27, 2000

By: Bruce D. DeRenzi
Bruce D. DeRenzi
Registration No. 33,676

Mailing Address:

MORGAN & FINNEGAN, L.L.P.
345 Park Avenue
New York, New York 10154
(212) 758-4800
(212) 751-6849 Telecopier

FORM: CPA-TRAN.NY
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27123

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PATENT

Docket No. 2122-4028US1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	:	Masato Okabe	Group Art unit : 2871
Serial No.	:	08/428,325	Examiner : W. Malinowski
Filed	:	April 25, 1995	
For	:	**PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD AND INFORMATION RECORDING SYSTEM**	

PETITION AND FEE FOR EXTENSION OF TIME (37 C.F.R. §1.136(a))

COMMISSIONER FOR PATENTS AND TRADEMARKS
Washington, D.C. 20231

Sir:

1. This is a petition for an extension of time for filing a Continued Prosecution Application.

2. The communication in connection with the matter for which this extension is requested

   [X] is filed herewith.

   [ ] has been filed on ______________________.

3. [ ] Applicant(s) is/are entitled to Small Entity Status. [ ] Small Entity Statement is attached. [ ] Statement has already been filed.

4.

		Total Months Requested	Fee for Other than Small Entity	Fee for Small Entity
a.	[ ]	one month	$110.00	$55.00
b.	[ ]	two months	$390.00	$195.00
c.	[X]	three months	$890.00	$445.00
d.	[ ]	four months	$1,390.00	$695.00
e.	[ ]	five months	$1,890.00	$945.00

f. [ ] An extension for _________ months has already been secured for filing the above-identified communication and the fee paid therefor of $ ___________ is deducted from the total fee due for the total months of extension now requested. The fee for this extension ($ ________), minus the fee previously paid ($ _________) equals $ ___________ (total fee due).

5. [X] A check in the amount of $890.00 to cover the extension fee is attached.

6. [ ] Charge fee to Deposit Account No. 13-4500. Order No. 2122-4028US1. A DUPLICATE COPY OF THIS SHEET IS ATTACHED.

7. [X] The Commissioner is hereby authorized to charge any additional fees which may be required by this paper, or credit any overpayment to Deposit Account No. 13-4500. Order No. 2122-4028US1. A DUPLICATE COPY OF THIS SHEET IS ATTACHED.

Respectfully submitted,

MORGAN & FINNEGAN, L.L.P.

Dated: December 27, 2000

By: Bruce D. DeRenzi

Bruce D. DeRenzi
Registration No. 33,676

CORRESPONDENCE ADDRESS:

MORGAN & FINNEGAN, L.L.P.
345 Park Avenue
New York, New York 10154
(212) 758-4800
(212) 751-6849 Facsimile

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Rev. 11/13/98

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DATE 12/27/2000

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Case No. 2122-4028~~US1~~ Serial No. 08/428,325

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Case No. 2122-4028[redacted] Serial No. 08/428,325

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27123
PATENT TRADEMARK OFFICE

PATENT
Docket No.2122-4028US1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s)	:	Masato Okabe	Group Art Unit:	2871
Serial No.	:	08/428,325	Examiner:	W. Malinowski
Filed	:	April 25, 1995		
For	:	**PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD AND INFORMATION RECORDING SYSTEM**		

EXPRESS MAIL CERTIFICATE

Express Mail Label No. **EF099148680US** EF 099148680 US

Date of Deposit **December 27, 2000**

I hereby certify that the following attached paper(s) and/or fee

1. Continued Prosecution Application Request Transmittal;
2. Petition and Fee For Three Month Extension of Time (in duplicate);
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Respectfully submitted,

MORGAN & FINNEGAN, L.L.P.

Dated: December 27, 2000

By: Bruce D. DeRenzi

Bruce D. DeRenzi
Registration No. 33,676

CORRESPONDENCE ADDRESS:

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
08/428,325	04/25/95	OKABE	M 2122-4028

MORGAN & FINNEGAN LLP

TM02/0302

MORGAN AND FINNEGAN
345 PARK AVENUE
NEW YORK NY 10154

EXAMINER	
MALINOWSKI, W	
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CASE 2122-4028 ATTY BDD
DUE DATE June 2, 2001
STATUTORY DATE September 2, 2001
BY

PTO-90C (Rev. 2/95)
*U.S. GPO: 2000-473-000/44602

2 - Mail Copy

Office Action Summary	Application No. 08/428,325	Applicant(s) OKABE, MASATO	
	Examiner Walter Malinowski	Art Unit 2164	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *27 December 2000* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *4-9, 13-15, and 19-28* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *4-9. 13-15, and 19-28* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

15) ☐ Notice of References Cited (PTO-892)
16) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
17) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
18) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
19) ☐ Notice of Informal Patent Application (PTO-152)
20) ☐ Other:

DETAILED ACTION

Drawings

The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference sign(s) not mentioned in the description: part number "63" of Fig. 42 is not identified in the specification. Correction is required.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

1. Claims 4-9, 13-15, and 19-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Takanshi et al. (Takanashi), U.S. Patent No. 5,315,410.

Takanashi discloses a photoelectric sensor including a photoconductive layer on an electrode and used to record information on an information recording medium (column 5, lines 50-60), characterized in that when voltage is applied to the sensor after the sensor has been exposed to light with no voltage applied thereto (as shown in Figs. 3-8; column 7, lines 39-68) or voltage of opposite polarity applied thereto.

Takanashi does not disclose a photo-induced current is generated depending upon exposure quantity so that the information can be recorded on the information recording medium.

Because Takanashi discloses an electric field is applied (column 7, lines 27-30) and light is provided to the photosensitive layer (column 6, line 37), photo-induced currents are generated.

Therefore, it would have been obvious a photo-induced current is generated depending upon exposure quantity so that the information can be recorded on the information recording medium in the device of Takanashi.

Furthermore, Takanashi does not disclose the exposed portion is made higher in conductivity than the unexposed portion and the exposed portion is kept still higher in conductivity than the unexposed portion even after the exposure of the sensor to information light has been finished, and while the sensor remains exposed to information light or after the exposure of the sensor to information light has been finished, nor the application of voltage of opposite polarity is applied thereto, and then the original voltage is again applied thereto, whereby the resulting conductivity is made equal to that obtained by the continued application of voltage.

Takanashi does disclose the impedance of the photoconductive layer 114 varies in accordance with the optical image of the object O, so that the electric field applied to the photo-modulation layer 111 depends on the optical image of object O and the application of the image-dependent electric field to the photo-modulation layer 111 forms a charge latent image on the photo-modulation layer 111 (column 12, lines 21-28). Takanashi also discloses that applied voltage time and amplitude may be varied (column 14, lines 15-25).

It would have been obvious to make the exposed portion higher in conductivity than the unexposed portion and keep the exposed portion still higher in conductivity than the unexposed portion even after the exposure of the sensor to information light has been finished so that the charge is reliably set in the recording medium.

Furthermore, it is well known to make the sensor exposed to information light or after the exposure of the sensor to information light has been finished, apply voltage of opposite polarity is applied thereto, and then the original voltage is again applied thereto, whereby the resulting conductivity is made equal to that obtained by the continued application of voltage to permit optimization of device performance.

Takanashi shows the image recording medium and the photoelectric sensor separated by an air gap (see Fig. 9). Since Takanashi teaches varying the applied voltage, it would have been obvious to optimize performance to comply with the reciprocity law.

Furthermore, Takanashi (see Fig. 10) shows the photoelectric sensor and the information recording medium being stacked on each other. Takanashi shows a mechanism 4 for starting the application of voltage to the electrodes.

Takanashi teaches the information recording medium is a liquid crystal recording medium including on the electrode a liquid crystal-polymer composite material layer comprising liquid crystals and resin (column 6, lines 1-5).

Since shutter speed and recording properties may be varied, it would have been obvious to satisfy the reciprocity law in optimizing performance.

Takanashi teaches the voltage applied is controlled.

2. Claims 20, 24, and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Takanshi et al. (Takanashi), U.S. Patent No. 5,315,410, as applied to Claims 4-9, 13-15, 19, 21-23, and 26-28 above, and further in view of Ando et al. (Ando), U.S. Patent No. 4,692,779, and Shimizu et al. (Shimizu), U.S. Patent No. 5,646,927.

Takanashi makes obvious the photoelectric sensor, but does not teach the photoelectric sensor is characterized in that when an electric field of 10^5 to 10^6 V/m is

applied to the sensor, a current passing through the unexposed portion has a current density of 10^{-4} to 10^{-7} A/cm^2.

Ando teaches that liquid crystal in an image forming apparatus have electric fields on the order of 10^5 to 10^6 V/m applied (column 4, line 63, through column 5, line 2).

Shimizu teaches generated photocurrent is about 10^{-6} A/cm^2 (column 26, lines 1-8).

Therefore, as to Claim 3, it would have been obvious to use an electric field of 10^5 to 10^6 V/m and a current of 10^{-4} to 10^{-7} A/cm^2, as suggested by Ando and Shimizu, in the device of Takanashi.

Response to Arguments

3. Applicant's arguments filed March 20, 2000, have been fully considered but they are not persuasive.

No arguments were provided in the amendment.

Conclusion

This is a CPA of applicant's earlier Application No. 08/428,325. All claims are drawn to the same invention claimed in the earlier application and could have been finally rejected on the grounds and art of record in the next Office action if they had been entered in the earlier application. Accordingly, **THIS ACTION IS MADE FINAL** even though it is a first action in this case. See MPEP § 706.07(b). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no, however, event will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Walter Malinowski whose telephone number is (703) 308-3172. The examiner can normally be reached on M-F 8:00 AM - 4:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Vincent Millin can be reached on (703) 308-1065. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-5401 for regular communications and (703) 308-5355 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Walter Malinowski

Walter J. Malinowski
Primary Examiner
Technology Center 2800

wjm
February 28, 2001

CORRESPONDENCE #14

UNITED STATES PATENT AND TRADEMARK OFFICE

RECEIVED DOCKET DEPT.

2001 APR 30 A 10: 15

COMMISSIONER FOR PATENTS
UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. 20231
www.uspto.gov

APPLICATION NUMBER	FILING DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	DRAWINGS	TOT CLAIMS	IND CLAIMS
08/428,325	04/25/1995	2871	0.00	2122-4028	30	18	5

CONFIRMATION NO. 4905

CORRECTED FILING RECEIPT

OC000000006001388

MORGAN AND FINNEGAN
345 PARK AVENUE

NEW YORK, NY 10154

Date Mailed: 04/24/2001

Receipt is acknowledged of this nonprovisional Patent Application. It will be considered in its order and you will be notified as to the results of the examination. Be sure to provide the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION when inquiring about this application. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please write to the Office of Initial Patent Examination's Customer Service Center. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the PTO processes the reply to the Notice, the PTO will generate another Filing Receipt incorporating the requested corrections (if appropriate).**

CASE 2122-4028 ATTY BDD
INFORMATION DISCLOSURE STATEMENT
FOREIGN FILING
CONVENTION DATE EXPIRES

Applicant(s)

MASATO OKABE, TOKYO, JAPAN;

Assignment For Published Patent Application

DAI NIPPON PRINTING CO., LTD.;

Domestic Priority data as claimed by applicant

Foreign Applications

JAPAN 089489 04/27/1994
JAPAN 091030 04/17/1995

Projected Publication Date: 08/02/2001

Non-Publication Request: No

Early Publication Request: No

Title

PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD, AND INFORMATION RECORDING SYSTEM

Preliminary Class

349

Data entry by : RIMANDO, EMELITA **Team :** OIPE **Date:** 04/24/2001

LICENSE FOR FOREIGN FILING UNDER
Title 35, United States Code, Section 184
Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CRF 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 36 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Office of Export Administration, Department of Commerce (15 CFR 370.10 (j)); the Office of Foreign Assets Control, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15 (b).

PLEASE NOTE the following information about the Filing Receipt:

- The articles such as "a," "an" and "the" are not included as the first words in the title of an application. They are considered to be unnecessary to the understanding of the title.
- The words **"new," "improved," "improvements in"** or **"relating to"** are not included as first words in the title of an application because a patent application, by nature, is a new idea or improvement.
- The title may be truncated if it consists of more than 600 characters (letters and spaces combined).
- The docket number allows a maximum of 25 characters.
- If your application was submitted under 37 CFR 1.10, your filing date should be the "date in" found on the Express Mail label. If there is a discrepancy, you should submit a request for a corrected Filing Receipt along with a copy of the Express Mail label showing the "date in."
- The title is recorded in sentence case.

Any corrections that may need to be done to your Filing Receipt should be directed to:

Assistant Commissioner for Patents
Office of Initial Patent Examination
Customer Service Center
Washington, DC 20231

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PATENT & TRADEMARK OFFICE

CORRESPONDENCE #15

Docket No. 2122-4028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): Masato Okabe

Group Art Unit: 2164

Serial No.: 08/428,325

Examiner: W. Malinowski

Filed: April 25, 1995

For: PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD AND INFORMATION RECORDING SYSTEM

NOTICE OF APPEAL TO THE BOARD OF PATENT APPEALS AND INTERFERENCES

Commissioner for Patents
Washington, D.C. 20231

Sir:

Applicant(s) hereby appeal(s) to the Board of Patent Appeals and Interferences from the decision(s) dated March 2, 2001 of the Primary Examiner. The items(s) checked below are appropriate:

- ☐ Fee not required (Fee paid in prior appeal)
- ☒ Appeal Fee Large Entity ($310)
- ☐ Small Entity Appeal Fee ($155)
- ☒ A check in the amount of $310.00 to cover the appeal fee is enclosed.
- ☐ Charge fee to Deposit Account No. 13-4500, Order No. _____. A DUPLICATE COPY OF THIS SHEET IS ATTACHED.
- ☒ The Commissioner is hereby authorized to charge any additional fees which may be required by this paper, or credit any overpayment to Deposit Account No. 13-4500, Order No. 2122-4028. A DUPLICATE COPY OF THIS SHEET IS ATTACHED.

Respectfully submitted,
MORGAN & FINNEGAN, L.L.P.

Dated: September 4, 2001

By: Bruce D. DeRenzi
Bruce D. DeRenzi
Registration No. 33,676

Correspondence Address:
MORGAN & FINNEGAN, L.L.P.
345 Park Avenue
New York, NY 10154-0053
(212) 758-4800 Telephone
(212) 751-6849 Facsimile

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6. ☐ Charge fee to Deposit Account No. 13-4500, Order No. _____. A DUPLICATE COPY OF THIS SHEET IS ATTACHED.

7. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required by this paper, or credit any overpayment to Deposit Account No. 13-4500. Order No. 2122-4028. A DUPLICATE COPY OF THIS SHEET IS ATTACHED.

Respectfully submitted,
MORGAN & FINNEGAN, L.L.P.

Dated: September 4, 2001

By: Bruce D. DeRenzi

Bruce D. DeRenzi
Registration No. 33,676

Correspondence Address:
MORGAN & FINNEGAN, L.L.P.
345 Park Avenue
New York, NY 10154-0053
(212) 758-4800 Telephone
(212) 751-6849 Facsimile

Docket No. 2122-4028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): Masato Okabe

Group Art Unit: 2164

Serial No.: 08/428,325

Examiner: W. Malinowski

Filed: April 25, 1995

For: PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD AND INFORMATION RECORDING SYSTEM

PETITION AND FEE FOR EXTENSION OF TIME (37 C.F.R. § 1.136(a))

Commissioner for Patents
Washington, D.C. 20231

Sir:

1. This is a petition for an extension of time for a Notice Of Appeal To The Board Of Patent Appeals And Interferences.

2. The communication in connection with the matter for which this extension is requested

☒ is filed herewith.

☐ has been filed on _____.

3. ☐ Applicant(s) is/are entitled to Small Entity Status.

☐ Statement has already been filed

4.

		Total Months Requested	Fee for Other than Small Entity	Fee for Small Entity
a.	☐	one month	$110.00	$55.00
b.	☐	two months	$390.00	$195.00
c.	☒	three months	$890.00	$445.00
d.	☐	four months	$1,390.00	$695.00
e.	☐	five months	$1,890.00	$945.00

f. ☐ An extension for _____ months has already been secured for filing the above-identified communication and the fee paid therefor of $_____ is deducted from the total fee due for the total months of extension now requested. The fee for this extension ($), minus the fee previously paid ($_____) equals $_____ (total fee due).

5. ☒ A check in the amount of $890.00 to cover the extension fee is attached.

Security enhanced document. See back for details.

MORGAN & FINNEGAN, L.L.P.
ATTORNEYS AT LAW
345 PARK AVE.
NEW YORK, NY 10154

24016

DATE September 4, 2001

1-8/210
280

PAY TO THE ORDER OF **COMMISSIONER OF PATENTS AND TRADEMARKS**

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$890.00¢ DOLLARS

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SORT NO. 2411
NEW YORK, N.Y. 10043

THE CITIBANK PRIVATE BANK

FOR 2122-4028

John C. Vassil

[redacted]

Security enhanced document. See back for details.

MORGAN & FINNEGAN, L.L.P.
ATTORNEYS AT LAW
345 PARK AVE.
NEW YORK, NY 10154

24017

DATE September 4, 2001

1-8/210
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NEW YORK, N.Y. 10043

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FOR 2122-4028

John C. Vassil

[redacted]

Case No. 2122-4028 Serial No. 08/428,325

Date Mailed September 4, 2001 ATTY BDD

Date Due in the Patent Office September 4, 2001

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1. Notice of Appeal To The Patent Appeals And Interferences (in duplicate);
2. Petition And Fee For Extension Of Time (37 C.F.R. § 1.136(a)) (in duplicate);
3. Certificate of Mailing;
4. Checks in the amount of $890.00 and $310.00; and
5. Return Receipt Postcard.

B. DeRenzi
B. Schaid

Case No. 2122-4028 Serial No. 08/428,325

Date Mailed September 4, 2001 ATTY BDD

Date Due in the Patent Office September 4, 2001

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1.- 1. Notice of Appeal To The Patent Appeals And
2.- Interferences (in duplicate);
3.- 2. Petition And Fee For Extension Of Time (37 C.F.R.
4.- § 1.136(a)) (in duplicate);
5.- 3. Certificate of Mailing;
6.- 4. Checks in the amount of $890.00 and $310.00; and
5. Return Receipt Postcard.

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B. DeRenzi
B. Scheid

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MORGAN & FINNEGAN LLP

MORGAN & FINNEGAN, L.L.P.
345 PARK AVENUE
NEW YORK, NEW YORK 10154-0053

10154-0004 44

Docket No. 2122-4028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): Masato Okabe

Group Art Unit: 2164

Serial No.: 08/428,325

Examiner: W. Malinowski

Filed: April 25, 1995

For: PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD AND INFORMATION RECORDING SYSTEM

CERTIFICATE OF MAILING (37 C.F.R. §1.8(a))

Commissioner for Patents
Washington, D.C. 20231

Sir:

I hereby certify that the attached:

1. Notice Of Appeal To The Board Of Patent Appeals And Interferences (in duplicate);
2. Petition And Fee For Extension Of Time (37 C.F.R. § 1.136(a)) (in duplicate);
3. Checks in the amount of $890.00 and $310.00; and
4. Return Receipt Postcard.

along with any paper(s) referred to as being attached or enclosed and this Certificate of Mailing are being deposited with the United States Postal Service on date shown below with sufficient postage as first-class mail in an envelope addressed to the: Commissioner for Patents, Washington, D.C., 20231.

Respectfully submitted,
MORGAN & FINNEGAN, L.L.P.

Dated: September 4, 2001

By: Bruce D. DeRenzi

Bruce D. DeRenzi
Registration No. 33,676

Correspondence Address:
MORGAN & FINNEGAN, L.L.P.
345 Park Avenue
New York, NY 10154-0053
(212) 758-4800 Telephone
(212) 751-6849 Facsimile

CORRESPONDENCE #16

↑AFFIX CUSTOMER NUMBER LABEL ABOVE↑

REQUEST FOR CONTINUED EXAMINATION (RCE) TRANSMITTAL	Application No.	08/428,325
Subsection (b) of 35 U.S.C. §132, effective on May 29, 2000, provides for continued examination of an utility or plant application filed on or after June 8, 1995.	Filing Date	April 25, 1995
See The American Inventors Protection Act of 1999 (AIPA)	First Named Inventor	Masato Okabe
	Group Art Unit	2164
	Examiner Name	Walter Malinowski
	Atty Docket No.	2122-4028

This is a Request for Continued Examination (RCE) under 37 C.F.R. §1.114 of the above-identified application.

NOTE: *37 C.F.R. §1.114 is effective on May 29, 2000. If the above-identified application was filed prior to May 29, 2000, applicant may wish to consider filing a continued prosecution application (CPA) under 37 C.F.R. §1.53(d) (PTO/SB/29) instead of a RCE to be eligible for the patent term adjustment provisions of the AIPA. See Changes to Application Examination and Provisional Application Practice,* Interim Rule, 65 *Fed. Reg.* 14865 (Mar. 20, 2000), 1233 *Off. Gaz. Pat. Office* 47 (Apr. 11, 2000*), which established RCE practice.*

1. **Submission under 37 C.F.R. §1.114**
   - a. ☐ Previously submitted
     - i. ☐ Consider the amendment(s)/reply under 37 C.F.R. §1.116 previously filed on ______. (Any unentered amendment(s) referred to above will be entered).
     - ii. ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on ______.
     - iii. ☐ Other:
   - b. Enclosed
     - i. ☒ Amendment/Reply
     - ii. ☐ Affidavit(s)/Declaration(s)
     - iii. ☐ Information Disclosure Statement (IDS)
     - iv. Other:

2. **Miscellaneous**
   - a. ☐ Suspension of action on the above-identified application is requested under 37 C.F.R. §1.103(c) for a period of ______ months. (Period of suspension shall not exceed 3 months; Fee under 37 C.F.R. §1.117(i) required)
   - b. Other:

3. **Fees** The RCE fee under C.F.R. §1.17(e) is required by 37 C.F.R. §1.114 when the RCE is filed
   - a. ☒ The Director is hereby authorized to charge the following fees, or credit any overpayments, to Deposit Account No. 13-4500, Order No. 2122-4028. A DUPLICATE COPY OF THE SHEET IS ATTACHED.
     - i. ☒ RCE fee required under 37 C.F.R. §.1.17(e)
     - ii. ☐ Extension of time fee (37 C.F.R. §§1.136 and 1.17)
     - iii. ☐ Other
   - b. ☐ Check in the amount of $ enclosed.

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

Name (Print/Type)	Arun Chandra	Reg. No. (Atty/Agent)	43,537
Signature		Date	November 5, 2001

661729 v1

PATENT Docket No. 2122-4028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	:	Masato Okabe	Group Art Unit: 2871
Serial No.	:	08/428,325	Examiner: W. Malinowski
Filed	:	April 25, 1995	
For	:	**PHOTOELECTRIC SENSOR, INFORMATION RECORDING SYSTEM AND INFORMATION RECORDING AND REPRODUCING METHOD**	

AMENDMENT

ASSISTANT COMMISSIONER OF PATENTS
Washington, D.C. 20231

Sir:

The present amendment is filed in response to the Office Action dated March 2, 2001.

REMARKS

Reconsideration of the present application as amended is respectfully requested. Claims 1-18 are pending as of the filing of this Amendment.

1. Drawings

The drawings were objected to as failing to comply with 37 C.F.R. 1.84(p)(5) because the reference to part number "63" in Figure 42 is not identified in the specification.

Applicant will correct Figure 42 and/or amend the specification to obviate this objection upon formal allowance of the pending claims.

2. Claim Rejections

The Examiner rejected claims 4-9, 13-15 and 19-28 under 35 U.S.C. § 103(a) as being unpatentable over Takanashi et al., U.S. Patent No. 5,315,410 ("Takanashi"). Applicants respectfully traverse this rejection.

The Examiner acknowledges that Takanashi does not disclose a photo-induced current that is dependent on the exposure quantity to allow the information to be recorded on the information recording medium. However, the examiner opines that because Takanashi also discloses that an electric field is applied and light is provided to the photosensitive layer, photo-induced currents are generated.

Applicants respectfully disagree. To establish a prima facie case of obviousness, the following basic conditions must be met: First, there must be some teaching, suggestion or motivation, either in the references themselves or in the general knowledge available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. MPEP §2143. Second, a prior art reference (or references when combined) must teach or suggest all the claim limitations. MPEP §2143. Applicants submit that none of these conditions are met.

As the Examiner acknowledges, Takanashi does not disclose a photo-induced current that is dependent on the exposure quantity to allow the information to be recorded on the information recording medium. Further, contrary to the Examiner's assertion, none of the cited references, singularly or in combination, disclose that "when voltage is applied to said

photoelectric sensor after **said photoelectric sensor has been exposed to light with no voltage applied thereto or voltage of opposite polarity applied thereto**, a photo-induced current is generated," as required by pending independent claim 4. Accordingly, it would not be obvious that a photo-induced current is generated depending upon exposure quantity so that the information can be recorded on said information recording medium as claimed.

Further, as the Examiner acknowledged, the cited references do not disclose that "the exposed portion is made higher in conductivity than the unexposed portion even after the exposure of said photoelectric sensor to information light has been finished, and while said photoelectric sensor remains exposed to information light or after the exposure of said photoelectric sensor to information light has been finished, the application of voltage thereto is interrupted or voltage of opposite polarity is applied thereto, whereby the resulting conductivity is made equal to that obtained by the continued application of voltage," as required by pending independent claim 8.

The Examiner notes, however, that Takanashi discloses that the impedance of the photoconductive layer varies in accordance with the optical image of the object, so that the electric field applied to the photo-modulation layer depends on the optical image of the object and the application of the image-dependent electric field to the photo-modulation layer forms a charge latent image on the photo-modulation layer. Takanashi discloses that applied voltage time and amplitude may be varied as well. Thus, the Examiner opines that "it would have been obvious to make the exposed portion higher in conductivity than the unexposed portion and keep the exposed portion still higher in conductivity than the unexposed portion even after the exposure of the sensor to information light has been finished so that the charge is reliably

set in the recording medium." Applicants respectfully disagree, and urge that not only does Takanashi fail to suggest the critical elements of the claimed invention, but that even if Takanashi's disclosure that "the impedance of the photoconductive layer varies in accordance with the optical image of the object" was implemented, the present invention's claimed objectives would not be met. Further, there is no suggestion in the cite references, taken singularly or in combination, that would cause one skilled in the art to find it "obvious to make the exposed portion higher in conductivity than the unexposed portion and keep the exposed portion still higher in conductivity than the unexposed portion even after the exposure of the sensor to information light has been finished so that the charge is reliably set in the recording medium." Applicants believe that such a conclusion is merely impermissible hindsight.

Next, the Examiner states that it was well known to expose the sensor to information light or to apply voltage of opposite polarity after completing exposure of the sensor to information light, and to again apply the original voltage to make the resulting conductivity equal to that obtained by the continued application of voltage to optimize the performance of the device. However, Applicants believe that none of the cited references disclose the elements of method or the system claimed in the present application. Thus, Applicants respectfully suggest that based on the cited references, it would not be obvious to optimize performance by complying with the reciprocity law in view of the teaching in Takanashi of varying the applied voltage.

The Examiner further rejected claims 20, 24 and 25 under 35 U.S.C. § 103(a) as being unpatentable over Takanashi as applied above in view of Ando et al. U.S. Patent No.

4,692,779 and Shimizu et al. U.S. Patent No. 5,646,927. In the Examiner's view, it would have been obvious to use an electric field of 10^5 to 10^6 V/m and a current of 10^{-4} to 10^{-7} A/cm^2, as suggested by Ando (see col. 4, line 63 - col. 5, line 2) and Shimizu (see col. 26, lines 1-8), in the device of Takanashi. Applicants respectfully traverse this rejection.

However, as noted above, Takanashi fails to disclose the elements of the present invention, and so claims 20, 24 and 25 should be considered patentable. Further, while Ando discloses that the intensity of its electric field is in the order of "0.5-10 X 10^6 V/m, which corresponds to the order of **1.5-44 X 10^{-5} coulomb/m^2** in terms of electric charges to be imparted," no where in Ando is it disclosed that "the photoelectric sensor is characterized in that when an electric field of 10^5 to 10^6 V/m is applied to said photoelectric sensor, a current passing through the unexposed portion has a current density of **10^{-4} to 10^{-7} A/cm^2**," as claimed. **10^{-4} to 10^{-7} A/cm^2** is equal to **1-10^{-3} A/m^2**. As the Examiner will appreciate, the range of the current density in the present invention is different from that in Ando or Shimizu.

Accordingly, Applicants respectfully submit that all the submitted independent claims should be found patentable. Further, all dependent claims are also patentable for depending from allowable independent claims.

CONCLUSION

Based on the foregoing remarks, it is respectfully submitted that the claims as currently pending are patentable and in condition for allowance.

If any issues remain, or if the Examiner has any suggestions for expediting allowance of this application, he is respectfully requested to contact the undersigned at the

telephone number listed below.

Favorable consideration is respectfully requested.

AUTHORIZATION

The Commissioner is hereby authorized to charge any additional fees which may be required for this amendment, or credit any overpayment to Deposit Account No. 13-4500, Order No. 2122-4028. **A DUPLICATE OF THIS DOCUMENT IS ATTACHED.**

Respectfully submitted,

MORGAN & FINNEGAN, L.L.P.

Date: November 5, 2001

By: ______________________
Arun Chandra
Registration No. 43,537

Correspondence Address

MORGAN & FINNEGAN, L.L.P.
345 Park Avenue
New York, New York 10154
(212) 758-4800
(212) 751-6849 (facsimile)

Case No. 2122-4028 Serial No. 08/428,325

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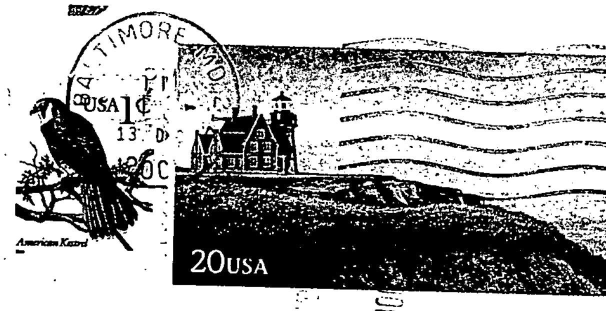

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Docket No. 2122-4028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): Masato Okabe

Group Art Unit: 2164

Serial No.: 08/428,325

Examiner: Walter Malinowski

Filed: April 25, 1995

For: PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD AND INFORMATION RECORDING SYSTEM

EXPRESS MAIL CERTIFICATE

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Arun Chandra, Esq.
MORGAN & FINNEGAN, L.L.P.
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2122-4028

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CORRESPONDENCE #17

PATENT Docket No. 2122-4028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	:	Masato Okabe	Group Art Unit: 2164
Serial No.	:	08/428,325	Examiner: Unknown
Filed	:	April 25, 1995	
For	:	**PHOTOELECTRIC SENSOR, INFORMATION RECORDING SYSTEM AND INFORMATION RECORDING AND REPRODUCING METHOD**	

Commissioner of Patents
Washington, D.C. 20231

STATUS INQUIRY

Sir:

On November 5, 2001 Applicant filed a Request for Continued Examination (RCE) of the above-referenced application. As of the date of this letter, Applicant has not received a response from the Patent and Trademark Office.

Accordingly, the Office is respectfully requested to advise applicant about the status of this application. The Office is urged to telephone undersigned at the number noted below if any further information is needed.

Respectfully submitted,

MORGAN & FINNEGAN, L.L.P.

Dated: June 17, 2003

By: Bruce D. DeRenzi

Bruce D. DeRenzi
Registration No. 33,676

Morgan & Finnegan, L.L.P.
345 Park Avenue
New York, New York 10154
Tel. No.: (212) 415-8750
Fax No.: (212) 751-6849

779260 v1

Case No. 2122-4028 Serial No. 08/428,325

Date Mailed June 18, 2003 ATTY BDD

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Case No. 2122-4028 Serial No. 08/428,325
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Docket No. 2122-4028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s):	Masato Okabe	Group Art Unit:	2164
Serial No.:	08/428,325	Examiner:	Unknown
Filed:	April 25, 1995		

For: PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD AND INFORMATION RECORDING SYSTEM

CERTIFICATE OF MAILING

Commissioner for Patents
Washington, D.C. 20231

Sir:

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Each of the above-enumerated papers are being deposited with the United States Postal Service on date shown below with sufficient postage as first-class mail in an envelope addressed to the: Commissioner for Patents, Washington, DC 20231.

Date: June 18, 2003

Jafet N. Cotto

(Typed or printed name of person mailing papers(s) and/or fee)

(Signature of person mailing paper(s) and/or fee)

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New York, NY 10154-0053
(212) 758-4800 Telephone
(212) 751-6849 Facsimile

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2122- 4028 DCS

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APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
08/428,325	04/25/1995	MASATO OKABE	2122-4028

CONFIRMATION NO. 4905

OC000000011786450

MORGAN AND FINNEGAN
345 PARK AVENUE

NEW YORK, NY 10154

Date Mailed: 01/29/2004

NOTICE OF NEW OR REVISED PROJECTED PUBLICATION DATE

The above-identified application has a new or revised projected publication date. The current projected publication date for this application is 04/15/2004. If this is a new projected publication date (there was no previous projected publication date), the application has been cleared by Licensing & Review or a secrecy order has been rescinded and the application is now in the publication queue.

If this is a revised projected publication date (one that is different from a previously communicated projected publication date), the publication date has been revised due to processing delays in the USPTO or the abandonment and subsequent revival of an application. The application is anticipated to be published on a date that is more than six weeks different from the originally-projected publication date.

More detailed publication information is available through the private side of Patent Application Information Retrieval (PAIR) System. The direct link to access PAIR is currently http://pair.uspto.gov. Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at (703) 305-3028.

Questions relating to this Notice should be directed to the Office of Patent Publication at (703) 305-8283.

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APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
08/428,325	04/25/1995	MASATO OKABE	2122-4028

CONFIRMATION NO. 4905

OC000000015105326

MORGAN AND FINNEGAN
345 PARK AVENUE

NEW YORK, NY 10154

Date Mailed: 02/03/2005

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Questions relating to this Notice should be directed to the Office of Patent Publication at (703) 305-8283.

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TO: Mr. Marcus	FROM: Jackie Waldo, Tech Support Staff Manager
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
08/428,325	04/25/1995	MASATO OKABE	2122-4028	4905

7590 08/10/2006

MORGAN AND FINNEGAN
345 PARK AVENUE
NEW YORK, NY 10154

EXAMINER	
MILLIN, VINCENT A	
ART UNIT	**PAPER NUMBER**
3624	

DATE MAILED: 08/10/2006

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.

EXAMINER

ART UNIT	PAPER NUMBER

DATE MAILED:

NOTICE UNDER 37 CFR 1.251 - Pending Application

☐ The file of the above-identified application cannot be located after a reasonable search. Therefore, the Office is initiating the reconstruction of the file of the above-identified application pursuant to the provisions of 37 CFR 1.251.

Applicant is given a period of **THREE (3) MONTHS** from the mailing date of this notice within which to provide a copy of applicant's record (if any) of all of the correspondence between the Office and applicant for the above-identified application (except for U.S. patent documents), a list of such correspondence, and a statement that the copy is a complete and accurate copy of applicant's record of all of the correspondence between the Office and the applicant for the above-identified application (except for U.S. patent documents), and whether applicant is aware of any correspondence between the Office and applicant for the above-identified application that is not among applicant's records.

☐ The following paper(s) pertaining to the above-identified application cannot be located after a reasonable search:
Along with the specified documents, please forward a copy of the application as filed.
Therefore, the Office is initiating the reconstruction of such paper(s) pursuant to the provisions of 37 CFR 1.251.

Applicant is given a period of **THREE (3) MONTHS** from the mailing date of this notice within which to provide a copy of the paper(s) listed above and a statement that the copy of such paper(s) is a complete and accurate copy of applicant's record of such paper(s).

Alternatively, applicant may reply to this notice by producing applicant's record (if any) of all of the correspondence between the Office and the applicant for the above-identified application for the Office to copy (except for U.S. patent documents), and provide a statement that the papers produced by applicant are applicant's complete record of all of the correspondence between the Office and the applicant for the above-identified application (except for U.S. patent documents), whether applicant is aware of any correspondence between the Office and the applicant for the above-identified application that is not among applicant's records. Such records must be brought to the Customer Service Center in the Office of Initial Patent Examination (Crystal Plaza 2, 2011 South Clark Place, Arlington, VA 22202).

If applicant does not possess any record of the correspondence between the Office and the applicant for the above-identified application (or any copy of the paper(s) listed above), applicant must reply to this notice by providing a statement that applicant does not possess any record of the correspondence between the Office and the applicant for the above-identified application.

Failure to reply to this notice in a timely manner will result in abandonment of the above-identified application. The three-month period for reply to this notice may be extended (up to a maximum of six months) under the provisions of 37 CFR 1.136(a). However, failure to reply within this three-month period will result in a reduction of any patent term adjustment. See 37 CFR 1.704(b).

☑ A printout from PALM of the contents of the file of the above-identified application is included with this notice.

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Direct questions concerning this notice to:

JACKIE WALDO
HEAD SUPERVISORY, LEGAL INSTRUMENTS EXAMINER TC 3600

(571) 272 - 6638.

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In re Application of: ______________________

Application No.: ______________________

Filing Date: ______________________

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NOTICE UNDER 37 CFR 1.251 - Pending Application

Statement (check the appropriate box):

☐ The copy submitted with this reply is a complete and accurate copy of applicant's record of all of the correspondence between the Office and the applicant for the above-identified application (except for U.S. patent documents), and applicant is not aware of any correspondence between the Office and applicant for the above-identified application that is not among applicant's records.

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Appln Info | **Contents** | Petition Info | Atty/Agent Info | Continuity/Reexam | Foreign Data | Inventors

Date	Status	Code	Description
08/10/2006		M2510	MAIL RECONSTRUCTION NOTICE - PENDING APPLICATION
08/09/2006	010 2053 B	2510	RECONSTRUCTION NOTICE UNDER 37 CFR 1.251 - PENDING APPL
06/16/2005		M2510	MAIL RECONSTRUCTION NOTICE - PENDING APPLICATION
06/16/2005		2510	RECONSTRUCTION NOTICE UNDER 37 CFR 1.251 - PENDING APPL
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04/23/2002		DOCK	CASE DOCKETED TO EXAMINER IN GAU
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09/07/2001	120	N/AP	NOTICE OF APPEAL FILED
09/07/2001	120	N/AP	NOTICE OF APPEAL FILED
09/07/2001		XT/G	REQUEST FOR EXTENSION OF TIME - GRANTED
09/13/1999		DOCK	CASE DOCKETED TO EXAMINER IN GAU
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03/02/2001	61	MCTFR	MAIL FINAL REJECTION (PTOL - 326)
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12/27/2000	71	ACPA	CONTINUING PROSECUTION APPLICATION - CONTINUATION (AC
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12/27/2000	168	ABN3	EXPRESS ABANDONMENT (DURING EXAMINATION)
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03/16/1998		G035	PREEXAMINATION LOCATION CHANGE
05/18/1995		INCD	NOTICE MAILED--APPLICATION INCOMPLETE--FILING DATE ASS

Appln Info | **Contents** | Petition Info | Atty/Agent Info | Continuity/Reexam | Foreign Data | Inventors

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CORRESPONDENCE #21

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
08/428,325	04/25/1995	MASATO OKABE	2122-4028	4905

7590 08/10/2006

MORGAN AND FINNEGAN
345 PARK AVENUE
NEW YORK, NY 10154

EXAMINER	
MILLIN, VINCENT A	
ART UNIT	**PAPER NUMBER**
3624	

DATE MAILED: 08/10/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.

EXAMINER

ART UNIT	PAPER NUMBER

DATE MAILED:

NOTICE UNDER 37 CFR 1.251 - Pending Application

☐ The file of the above-identified application cannot be located after a reasonable search. Therefore, the Office is initiating the reconstruction of the file of the above-identified application pursuant to the provisions of 37 CFR 1.251.

Applicant is given a period of THREE (3) MONTHS from the mailing date of this notice within which to provide a copy of applicant's record (if any) of all of the correspondence between the Office and applicant for the above-identified application (except for U.S. patent documents), a list of such correspondence, and a statement that the copy is a complete and accurate copy of applicant's record of all of the correspondence between the Office and the applicant for the above-identified application (except for U.S. patent documents), and whether applicant is aware of any correspondence between the Office and applicant for the above-identified application that is not among applicant's records.

☐ The following paper(s) pertaining to the above-identified application cannot be located after a reasonable search:

Along with the specified documents, please forward a copy of the application as filed

Therefore, the Office is initiating the reconstruction of such paper(s) pursuant to the provisions of 37 CFR 1.251.

Applicant is given a period of THREE (3) MONTHS from the mailing date of this notice within which to provide a copy of the paper(s) listed above and a statement that the copy of such paper(s) is a complete and accurate copy of applicant's record of such paper(s).

Alternatively, applicant may reply to this notice by producing applicant's record (if any) of all of the correspondence between the Office and the applicant for the above-identified application for the Office to copy (except for U.S. patent documents), and provide a statement that the papers produced by applicant are applicant's complete record of all of the correspondence between the Office and the applicant for the above-identified application (except for U.S. patent documents), whether applicant is aware of any correspondence between the Office and the applicant for the above-identified application that is not among applicant's records. Such records must be brought to the Customer Service Center in the Office of Initial Patent Examination (Crystal Plaza 2, 2011 South Clark Place, Arlington, VA 22202).

If applicant does not possess any record of the correspondence between the Office and the applicant for the above-identified application (or any copy of the paper(s) listed above), applicant must reply to this notice by providing a statement that applicant does not possess any record of the correspondence between the Office and the applicant for the above-identified application.

Failure to reply to this notice in a timely manner will result in abandonment of the above-identified application. The three-month period for reply to this notice may be extended (up to a maximum of six months) under the provisions of 37 CFR 1.136(a). However, failure to reply within this three-month period will result in a reduction of any patent term adjustment. See 37 CFR 1.704(b).

☑ A printout from PALM of the contents of the file of the above-identified application is included with this notice.

Direct the reply to this notice to:

* Copy of document needed

Box Reconstruction
United States Patent and Trademark Office
ALEXANDRIA, VA 22313-1450

Direct questions concerning this notice to:

JACKIE WALDO
HEAD SUPERVISORY, LEGAL INSTRUMENTS EXAMINER TC 3600

(571) 272 - 6630

jackie.waldo@uspto.gov

Please call or e-mail for Fed Ex instructions

FORM PTO-2053-A (REV. 11/2000)

* PLEASE INCLUDE A REQUEST FOR CHANGE OF ADDRESS

FORM PTO-2053-B (REV. 11/2000)
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U.S. Patent and Trademark Office; U. S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

In re Application of: ______________________

Application No.: ______________________

Filing Date: ______________________

Title: ______________________

____

Direct to:

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United States Patent and Trademark Office
ALEXANDRIA, VA 22313-1450

NOTICE UNDER 37 CFR 1.251 - Pending Application

Statement (check the appropriate box):

☐ The copy submitted with this reply is a complete and accurate copy of applicant's record of all of the correspondence between the Office and the applicant for the above-identified application (except for U.S. patent documents), and applicant is not aware of any correspondence between the Office and applicant for the above-identified application that is not among applicant's records.

☐ The copy of the paper(s) listed in the notice under 37 CFR 1.251 is/are a complete and accurate copy of applicant's record of such paper(s).

☐ The papers produced by applicant are applicant's complete record of all of the correspondence between the Office and the applicant for the above-identified application (except for U.S. patent documents), and applicant is not aware of any correspondence between the Office and the applicant for the above-identified application that is not among applicant's records.

☐ Applicant does not possess any record of the correspondence between the Office and the applicant for the above-identified application.

____
Date

____
Signature

____
Typed or printed name

A copy of this notice should be returned with the reply.

Burden Hour Statement: This collection of information is required by 37 CFR 1.251. The information is used by the public to reply to a request for copies of correspondence between the applicant and the USPTO in order to reconstruct an application file. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This form is estimated to take 60 minutes to complete. This time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

Day : Wednesday
Date: 8/9/2006
Time: 15:27:09

PALM INTRANET

Content Information for 08/428325

Search Another: Application# Search **or Patent#** Search

PCT / / Search **or PG PUBS #** Search

Attorney Docket # Search

Bar Code # Search

Appln Info | **Contents** | Petition Info | Atty/Agent Info | Continuity/Reexam | Foreign Data | Inventors

Date	Status	Code	Description
08/10/2006		M2510	MAIL RECONSTRUCTION NOTICE - PENDING APPLICATION
08/09/2006	0102053-B	2510	RECONSTRUCTION NOTICE UNDER 37 CFR 1.251 - PENDING APPL
06/16/2005		M2510	MAIL RECONSTRUCTION NOTICE - PENDING APPLICATION
06/16/2005		2510	RECONSTRUCTION NOTICE UNDER 37 CFR 1.251 - PENDING APPL
02/17/2005		LFLOST	FILE MARKED LOST
10/30/2002		LFFOUND	FILE MARKED FOUND
05/24/2002		LFLOST	FILE MARKED LOST
04/23/2002		DOCK	CASE DOCKETED TO EXAMINER IN GAU
04/23/2002		DOCK	CASE DOCKETED TO EXAMINER IN GAU
11/05/2001		BRCE	WORKFLOW - REQUEST FOR RCE - BEGIN
11/06/2001		DOCK	CASE DOCKETED TO EXAMINER IN GAU
09/18/2001		DOCK	CASE DOCKETED TO EXAMINER IN GAU
09/07/2001	120	N/AP	NOTICE OF APPEAL FILED
09/07/2001	120	N/AP	NOTICE OF APPEAL FILED
09/07/2001		XT/G	REQUEST FOR EXTENSION OF TIME - GRANTED
09/13/1999		DOCK	CASE DOCKETED TO EXAMINER IN GAU
07/18/2001		DOCK	CASE DOCKETED TO EXAMINER IN GAU
03/02/2001	61	MCTFR	MAIL FINAL REJECTION (PTOL - 326)
03/02/2001	60	CTFR	FINAL REJECTION
01/25/2001		DOCK	CASE DOCKETED TO EXAMINER IN GAU
01/05/2001		FWDX	DATE FORWARDED TO EXAMINER
12/27/2000	71	ACPA	CONTINUING PROSECUTION APPLICATION - CONTINUATION (AC
12/27/2000		MABN3	MAIL EXPRESS ABANDONMENT (DURING EXAMINATION)
12/27/2000	168	ABN3	EXPRESS ABANDONMENT (DURING EXAMINATION)
12/27/2000		XT/G	REQUEST FOR EXTENSION OF TIME - GRANTED
12/27/2000		BCPA	WORKFLOW - REQUEST FOR CPA - BEGIN
06/27/2000	61	MCTFR	MAIL FINAL REJECTION (PTOL - 326)
06/27/2000	60	CTFR	FINAL REJECTION
04/25/1995	19	IEXX	INITIAL EXAM TEAM NN

04/24/2000		FWDX	DATE FORWARDED TO EXAMINER
03/20/2000	71	A...	RESPONSE AFTER NON-FINAL ACTION
03/20/2000		XT/G	REQUEST FOR EXTENSION OF TIME - GRANTED
11/01/1999		RQPR	REQUEST FOR FOREIGN PRIORITY (PRIORITY PAPERS MAY BE IN
09/15/1999	41	MCTNF	MAIL NON-FINAL REJECTION
09/13/1999	40	CTNF	NON-FINAL REJECTION
08/24/1999	30	DOCK	CASE DOCKETED TO EXAMINER IN GAU
10/06/1997		TR.Q	TRANSFER INQUIRY
03/16/1998		G035	PREEXAMINATION LOCATION CHANGE
05/18/1995		INCD	NOTICE MAILED--APPLICATION INCOMPLETE--FILING DATE ASS

Appln Info | **Contents** | Petition Info | Atty/Agent Info | Continuity/Reexam | Foreign Data | Inventors

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CORRESPONDENCE #22

27123
↑CUSTOMER NUMBER↑

Fee

Docket No. 2122-4028

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	:	Masato Okabe	Group Art Unit:	3624
Serial No.	:	08/428,325	Examiner:	Millin, Vincent A.
Filed	:	April 25, 1995	Confirmation No.:	4905
For	:	PHOTOELECTRIC SENSOR, INFORMATION RECORDING SYSTEM AND INFORMATION RECORDING AND REPRODUCING METHOD		

TRANSMITTAL OF FILE CONTENTS IN RESPONSE TO NOTICE UNDER 37 CFR 1.251 – PENDING APPLICATION

Mail Stop ____
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In response to the "Notice Under 37 CFR § 1.251 – Pending Application" sent via facsimile from the USPTO on August 9, 2006, Applicants now submit herein the following documents requested by Jackie Waldo, Head Supervisory Legal Instruments Examiner for TC 3600, to assist in the reconstruction of Application No. 08/428,325 now deemed lost. The following documents are enclosed:

☒ Copy of Notice Under 37 CFR 1.251 – Pending application.

☒ Copy of requested documents, per PALM Content Information for Appln. Ser. No. 08/428,325, dated August 9, 2006.

☒ Copy of application as-filed on April 25, 1995.

☒ Applicant(s) do not believe a fee is associated with this Response. However, the Commissioner is hereby authorized to charge any additional fees which may be required for filing this paper, or credit any overpayment to Deposit Account No. 13-4500, Order No. 2122-4028. A DUPLICATE COPY OF THIS SHEET IS ATTACHED.

Respectfully submitted,
MORGAN & FINNEGAN, L.L.P.

Dated: October 2, 2006

By: [signature]
Elliot L. Frank
Registration No. 56,641
(202) 857-7887 Telephone
(202) 857-7929 Facsimile

Correspondence Address:

MORGAN & FINNEGAN, L.L.P.
3 World Financial Center
New York, NY 10281-2101

76871 v1

MORGAN & FINNEGAN, LLP – DC OFFICE

Serial No.	**08/428,325**	Docket No.	**2122-4028**
Applicant:	**Okabe**	Atty.:	**ELF/jag**
Filing Date:	**April 25, 1995**	Due Date:	**November 9, 2006**

DELIVER TO Attn: Ms. Jackie Waldo, Technology Center 3600, 501 Delaney Street, Room 4D55, Knox Building, Alexandria, VA 22313

The following was/ were received in the U.S. Patent and Trademark Office on the date stamped hereon:

☒ Transmittal of File Contents in Response to Notice Under 37 CFR 1.251

☒ Copy of Notice Under 37 CFR 1.251 – Pending application.

☒ Copy of requested documents, per PALM Content Information for Appln. Ser. No. 08/428,325, dated August 9, 2006.

☒ Copy of application as-filed on April 25, 1995

OIPE IAP68 OCT 17 2006 PATENT & TRADEMARK OFFICE

CORRESPONDENCE #23

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
08/428,325	04/25/1995	MASATO OKABE	2122-4028

CONFIRMATION NO. 4905

NEW OR REVISED PPD NOTICE

MORGAN AND FINNEGAN
345 PARK AVENUE
NEW YORK, NY 10154

OC000000031168595

Date Mailed: 07/24/2008

NOTICE OF NEW OR REVISED PROJECTED PUBLICATION DATE

The above-identified application has a new or revised projected publication date. The current projected publication date for this application is 09/25/2008. If this is a new projected publication date (there was no previous projected publication date), the application has been cleared by Licensing & Review or a secrecy order has been rescinded and the application is now in the publication queue.

If this is a revised projected publication date (one that is different from a previously communicated projected publication date), the publication date has been revised due to processing delays in the USPTO or the abandonment and subsequent revival of an application. The application is anticipated to be published on a date that is more than six weeks different from the originally-projected publication date.

More detailed publication information is available through the private side of Patent Application Information Retrieval (PAIR) System. The direct link to access PAIR is currently http://pair.uspto.gov. Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Questions relating to this Notice should be directed to the Office of Data Management, Application Assistance Unit at (571) 272-4000, or (571) 272-4200, or 1-888-786-0101.

DOCKET DEPARTMENT

Docketed By: AB Date: 08/06/08
Audited By: gm Date: 8/6/08
Filed By: ____ Date: ____

M F 08/06/08 AM10:20

CORRESPONDENCE #24

UNITED STATES PATENT AND TRADEMARK OFFICE

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Alexandria, Virginia 22313-1450
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
08/428,325	04/25/1995	MASATO OKABE	2122-4028

CONFIRMATION NO. 4905

PUBLICATION NOTICE

OC000000032265944

MORGAN AND FINNEGAN
345 PARK AVENUE
NEW YORK, NY 10154

Title:PHOTOELECTRIC SENSOR, INFORMATION RECORDING METHOD, AND INFORMATION RECORDING SYSTEM

Publication No.US-2008-0231768-A1
Publication Date:09/25/2008

...ated By: AL Date: 10/08/08
Audited By: Date: 10/8/08
Filed By: Date:

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Office of Public Records. The Office of Public Records can be reached by telephone at (703) 308-9726 or (800) 972-6382, by facsimile at (703) 305-8759, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently http://pair.uspto.gov/. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

M F 10/08/08 AM 7:46:

CORRESPONDENCE #25

UNITED STATES PATENT AND TRADEMARK OFFICE

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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
08/428,325	04/25/1995	MASATO OKABE	2122-4028	4905

7590 06/15/2009

MORGAN AND FINNEGAN
345 PARK AVENUE
NEW YORK, NY 10154

EXAMINER	

ART UNIT	PAPER NUMBER

DATE MAILED: 06/15/2009

Please find below and/or attached an Office communication concerning this application or proceeding.

UNITED STATES DEPARTMENT OF COMMERCE
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Alexandria, Virginia 22313-1450

APPLICATION NO./ CONTROL NO.	FILING DATE	FIRST NAMED INVENTOR / PATENT IN REEXAMINATION	ATTORNEY DOCKET NO.
08428325	4/25/95	OKABE, MASATO	2122-4028

MORGAN AND FINNEGAN
345 PARK AVENUE
NEW YORK, NY 10154

EXAMINER	
KENNETH A. PARKER	
ART UNIT	PAPER
2815	20090402

DATE MAILED:

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner for Patents

Kenneth A Parker
SPE
Art Unit: 2815

Notice of Non-Responsive Reply

On August 10, 2006, a notice under 37 CFR 1.251 initiating reconstruction of application no. 08/428,325 was sent to applicant. On October 17, 2006 applicant submitted a reply to that notice. For the reasons indicated below, the reply was not fully responsive to that notice.

The notice of August 10/ 2006 under 37 CFR 1.251 required applicants provide a copy of applicant's record or produce applicant's record (if any) of:

1) All of the correspondence between the Office and applicant for the above-identified application (except for U.S. patent documents),
2) a list of such correspondence, and
3) a statement that the copy is a complete and accurate copy of applicant's record of all of the correspondence between the Office and the applicant for the above-identified application (except for U.S. patent documents), and whether applicant is aware of any correspondence between the Office and applicant for the above-identified application that is not among applicant's records.

The reply of August 10, 2008 is incomplete due to following omission(s) or matter(s):

1) **The statement required by 37 CFR 1.251(a)(1)(iii) has not been provided**; i.e., the statement that "*the copy of papers produced by applicant on October 17, 2006 is a complete and accurate copy of applicant's record of all of the correspondence between the Office and the applicant for application no. 08/428,325*", and a statement stating whether "*the applicant is aware of any correspondence between the Office and applicant for application no. 08/428,325 that is not among applicant's records*" was not provided.

2) **The list of the submitted correspondence required by 37 CFR 1.251(a)(1)(ii) has not been provided.**

3) **The papers submitted on October 17, 2006 may be incomplete.** Applicant indicated, in the paper filed on October 17, 2006, entitled "*Transmittal of File Contents in Response to Notice Under 37 CFR 1.251 -- Pending Application*", that the documents provided were only those listed in PALM (see the second checked box of the above-identified October 17, 2006 transmittal paper). This statement, however, omits any papers submitted after the file was lost, and any other papers that may have been submitted but inadvertently have not been listed in PALM.

Once the file is lost, the PALM records do not include any papers that may have been submitted after the time that the file was lost. There have also been occurrences where papers that have been submitted were inadvertently not listed in PALM. **As applicant indicated that applicant has only submitted those papers that were listed in PALM, *i.e., only those papers of record prior to the time that the file was listed as lost, and only those papers that were both submitted AND listed in PALM,* it would appear that the papers submitted on October 17, 2006 may be incomplete.**

Conclusion

The notice under 1.251 explicitly indicated "With regard to a pending application, failure to comply with one of paragraphs (a)(1), (a)(2), or (a)(3) of this section within the time period set in the notice will result in abandonment of the application," and applicant has not complied with the requirement during the time period set. See 37 CFR 1.251(b). Applicant is now given **ONE (1) MONTH or THIRTY (30) DAYS** from the mailing date of this notice, whichever is longer, within which to supply the omission or correction in order to avoid abandonment. NO extensions of time under 37 CFR 1.136(a) will be permitted.

Any question regarding this communication should be directed to Ken Parker, SPE 2800 at 571-272-2298.

/Kenneth A Parker/

Supervisory Patent Examiner, Art Unit 2815

CORRESPONDENCE #26

Organization TC2800 Bldg./Room Jeff

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FJ/-

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Alexandria, Virginia 22313-1450

APPLICATION NO./ CONTROL NO.	FILING DATE	FIRST NAMED INVENTOR / PATENT IN REEXAMINATION	ATTORNEY DOCKET NO.
08428325	4/25/95	OKABE, MASATO	2122-4028

MORGAN AND FINNEGAN
345 PARK AVENUE
NEW YORK, NY 10154

EXAMINER	
KENNETH A. PARKER	
ART UNIT	**PAPER**
2815	20090402

DATE MAILED:

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner for Patents

Kenneth A Parker
SPE
Art Unit: 2815

PTO-90C (Rev.04-03)

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/Kenneth A Parker/

Supervisory Patent Examiner, Art Unit 2815